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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

Institute of British Foundrymen.

FEBRUARY 12.

Lancashire Branch (Burnley Section):—Ordinary meeting at Burnley. "Black Sands," Paper by B. Hird.

Middlesbrough Branch:—Ordinary meeting. "Some Aspects of Modern Foundry Practice," Paper by F. Griffiths.

FEBRUARY 13.

West Riding of Yorkshire Branch:—Ordinary meeting. "Some Physical Properties of Cast Iron," Paper by H. W. Swift, M.A., D.Sc.

FEBRUARY 16.

Scottish Branch:—Ordinary meeting at Glasgow. "Jobbing Moulding in a Jobbing Foundry," Paper by A. Sutcliffe.

FEBRUARY 18.

London Branch:—Ordinary meeting. "The Italian Foundry Industry," Paper by Dr. Guido Vanzetti.

FEBRUARY 19.

Sheffield and District Branch:—Ordinary meeting. "The Use of Pulverised Fuel and Pulverising Machines in the Foundry," Paper by P. Hawden.

FEBRUARY 20.

Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. "Some Aspects of the Foundry from a Moulder's Point of View," Paper by E. Flower.

The Creep Test.

We have previously drawn attention in our columns to the comparative excellence of castings under what is known as the creep test, compared with forgings and wrought products. For example, in Spring's Paper to the last Institute of British Foundrymen's Convention he showed a number of curves in which some cast steels were decidedly better under creep than the forged steels. The tremendous increase in pressures and temperatures at which metals are expected to work in modern power plant has put an entirely new complexion on mechanical testing, and the ordinary static tests are of comparatively little value for such service. It has been realised only during the past few years that at a high temperature any material will flow slightly under load, and methods of testing creep are largely designed to ensure a more sensitive type of apparatus. Many special materials have been developed to meet severe service conditions, and it is singular that the more modern methods of testing, such as fatigue testing, creep testing, show the simpler materials to relatively greater advantage.

An investigation has recently been published by the Department of Scientific and Industrial Research comparing a forged steel with a cast steel of similar composition over the range 400 to 650 deg. C. The results show that in this case cast steel is not quite so good as the forged steel at about 500 deg. C. The limiting creep stress of the cast steel was 4 tons per sq. in., and the forged steel 5 tons per sq. in., *i.e.*, these stresses respectively would produce an elongation of one part in 100,000 per day, which is assumed to correspond with a reasonably long service life. The difference is small and might be due to the fact that the compositions, although similar, were not the same.

It is obvious that for high-temperature service heat-treated material is useless, and this excludes any material, such as malleable iron, subject to a constitutional change at a high temperature. It has also been found that austenitic steels offer greater resistance to creep than the pearlitic or ferritic steels. We have previously suggested the desirability of creep tests on cast iron, and the development of austenitic irons suggests that both the ordinary and austenitic types should be included in such tests.

One of the principal reasons for the advantage of cast metals seems to be their comparatively large grain size, and here again it would seem an advantage to adopt methods of production which yield a large grain size in cast iron, and hence an annealing process offers possibilities. The most striking feature of these developments is the fact that the elastic limit on which most engineers design their structures virtually disappears, and this puts cast iron, popularly supposed to have no elastic limit, in an entirely different light. Creep testing is expensive, laborious and slow, but we hope that ways and means will be found for ascertaining creep values of different types of iron used for engineering purposes. They may well prove that cast iron, which is inferior to the steels in the cold, may display claims for consideration for service at elevated temperatures.

Cupola Costing and "Foreign" Scrap.

From our Editorial, "A Paper Wangle," there arises quite a number of interesting points which require some elaboration. Our assertions were related only to cases where the cost-of-metal-at-the-spout or in-the-ladle are used as a basis figure for the ascertaining of cost for the purpose of quoting. Obviously this is not the only method, but where a variety of work has to be made it is an extremely useful figure. Where large quantities of the same type of casting are made, Dundydan's method is better. It was first enunciated by Mr. A. W. G. Bagshawe several years ago in a Paper he presented to the London Section of the Institute of British Foundrymen. This method is based upon average annual expenditure upon *everything* appertaining to the production of metal divided by the weight of saleable casting made during the same period. The defect of this method is that bad moulding practice is debited against the melting costs, but as a method for quantity production costing it is ideal. Mr. Gray's statement that "there is not a foundry in the country that can give a true *cost-of-metal-at-the-spout* figure," whilst a slight exaggeration, is mathematically correct as its ascertainment to the last half-penny would cost more than it is worth. Some of the factors often omitted are kindling wood (sometimes consisting of expensive packing cases); full transport of raw materials and slag; laboratory control; small tools; damage to roofs by dust, or at least the consequent periodical cleaning; deterioration of stocks during storage; and melting losses. Mr. Jobson, in his refusal to buy "foreign" scrap is quite wise, because in his case every casting is trade-marked "Qualcast," and the incident of a defective part being detected after inadequate life becomes infinitely more serious. Other foundries, before using any consignment of scrap make a representative melt and analyse the product

(*Concluded on next page.*)

XUM

Sheffield Founders' Annual Dinner.

A number of matters affecting the foundry trade, including protective tariffs, were touched upon by speakers at the annual dinner of the Sheffield and District Branch of the Institute of British Foundrymen, held at the Royal Victoria Hotel, Sheffield, on February 5.

Mr. G. C. Castle (Branch-President) presided, and the guests included the Lord Mayor of Sheffield (Alderman T. H. Watkins), Mr. Arthur Neal (President of the Sheffield Chamber of Commerce), Mr. Victor Stobie, of Newcastle (Senior Vice-President of the Institute), and Mr. Vincent C. Faulkner (Past-President and Editor of The Foundry Trade Journal).

Sheffield's Educational Move.

Mr. Neal proposed the toast of "The Institute of British Foundrymen and the Sheffield Branch." He alluded to the setting up of a committee by the Chamber recently in anticipation of the imposition of tariffs on imported goods. The Chamber felt that if imports were to be restricted it was essential that the industries of Sheffield should not be caught napping. The committee had since been reconstituted on a wider plane so that it was not confined to the Chamber of Commerce, and he could only hope that the committee would secure for the industries of Sheffield the maximum benefits that his protectionist friends thought possible and avoid as far as could be avoided those evils which were inseparable from any tariff system. Anyone who believed that any change in the fiscal system was in itself going to be a panacea which would re-establish us as a nation was living in a fool's paradise. It was only one of many problems, and the great problem at the moment was to try to maintain the present value of the £ at home. It was essential that every trade and industry, including the foundry trade, should be fully organised and examine with scrupulous care all questions that affected costs to enable them at least to say that they did not shelter inefficient works and industries behind a barrier of tariff walls.

Speaking directly to the toast, Mr. Neal said that the foundryman's work appeared to call for a combination of designing skill, managerial skill and a high craftsmanship, without which it was impossible to produce that result which was so much to be desired in the great industry with which they were connected.

Responding to the toast, the Chairman said that Sheffield was particularly interested in the Institute, inasmuch as several of the founding members came from Sheffield. In this connection he recalled Mr. Ambrose Firth, whose descendants were among the company that evening. In spite of the difficulties of the times, the Institute during the last few months had enlisted about 100 new members. He believed that this was a record for such a short period. The British foundry industry was in need of better methods, improved technique and the lowering of costs. He appealed to the employers to do something to encourage the youths and the apprentices to attend the various meetings that the Institute held throughout its branches. He suggested that the employers might adopt a scheme whereby marks would be given to the youths for their attendance at Branch meetings and at the technical classes of which they in Sheffield were so proud. Some scheme of this sort would, he felt sure, benefit not only the young people concerned but the industry in general.

The toast of "Our Guests" was offered by Mr. C. D. Pollard (Senior Vice-President of the Sheffield Branch of the Institute), and Mr. W. Macartney (President of the Sheffield Section of the Junior Institution of Engineers) responded.

Educational Suggestion.

Mr. Macartney said he was well aware that foundrymen had been through a hard time. He knew something about an iron foundry, and he was thankful that it was not a steel foundry. In regard to what the Chairman had said about the training of youths, he himself felt that where the foundry was rather apt to fail was that the technical training did not give the youths a sufficiently practical experience in foundry work. He would like to draw attention to a foundry in connection with the technical school in Sheffield. The chief of the foundry had a class of twelve or fifteen boys from the technical school, and for two hours each week while the classes were in session the boys were taught the practical work of the foundry. He would like to suggest to foundry people that the head foremen of various works might be persuaded to take classes for the youths. He was sure that such a scheme would make for more practical knowledge for the youths. In regard to tariffs, he noted that some people thought that the imposition of a 10 per cent. duty was insufficient, but he held the view that half a loaf was better than none, and that eventually there would be a higher tariff so far as the foundry trade was concerned if such was found to be advantageous.

Mr. Stobie proposed the toast of "The City of Sheffield." As an old resident he congratulated the city upon its progress and upon the efficiency of the works. Most of the works of the city, he said, were right up to date. Sheffield gave a lead to the world in many directions.

The Lord Mayor replied, and assured the Institute of his best wishes for its welfare. He believed in the collective efforts of all the units composing the different industries.

An enjoyable musical programme was provided, and a novelty in connection with the dinner was the arrival of one of the courses, with lowered lights, in the form of an ice course carried into the room by the chef. On the large tray was an illuminated block of ice in the design of a cupola.

Cupola Costing and "Foreign" Scrap.

(*Concluded from previous page.*)

before actually using it as a raw material, which system, of course, is not cheap, but is quite effective, and desirable where the quality of the castings is to be unimpeachable. It must be borne in mind that there is no common denominator in foundry practice, and so long as iron founders are content to put up with semi-mechanical methods of melting, there must be exercised the greatest care in the selection of raw materials. Thousands of tons of alloyed cast iron have been made in recent years, and when this finally augments the world's scrap pile the foundries taking any chance on uncontrolled scrap usage will encounter endless trouble. So far as our original assertion is concerned, that is, where the cost-of-metal-at-the-spout is used as a basic figure in any costing process, then the pricing of domestic scrap at a figure lower than that at which it could be bought from an outside source is nothing more or less than self-deception and well warrants the designation which we gave—A Paper "Wangle."

Qualcast, Limited.—In a circular, enclosed with the warrant for the interim dividend of 5 per cent., the directors of Qualcast, Limited, Derby, state that the profits for the six months to December 31 are within £500 of those earned during the corresponding period of 1930, and the tonnage produced by the foundry department shows an increase of 5 per cent. Referring to the duty which has been applied upon foreign manufactured lawn movers, the directors state that unfortunately this came too late to prevent very serious dumping taking place, but so soon as these dumped stocks are out of the way this department of the works should feel considerable benefit from the elimination of the foreigner, and they do not anticipate that the application of duties will in any way react unfavourably to the purchasing public; they anticipate the reverse.

Random Shots.

Cell DBa94'uE & B36'f120'667tFPT118tAPT123

How's that for an abbreviation? "Marksman" spotted it in a recent examination paper in shipbroking, and shipbrokers ever since have held high place in his estimation. Chemists and landladies, well versed though they be in the gentle art of abbreviation, will never again impress him as of yore.

* * *

That *enfant terrible* of the civilised world, the U.S.S.R., is nowadays a very "nought-y" country. According to report more than 3,000,000,000 roubles—worth around £400,000,000—have been invested in the Russian coal and metallurgical industries during the past three years. The scheduled output of pig-iron for the present year is 10 million tons, but how the Soviets are going to achieve this ambitious figure is just what the Soviets are wondering. Last year their aim was to produce 8 million tons, and their output fell short rather feebly at 4,700,000 tons. Consequently 13 million tons will have to be produced in 1932 if the schedule is to be adhered to. And so far the average daily output is said to be only 16,000 tons. It isn't good enough!

* * *

Talking of pig-iron production, our own languished rather badly in December. It was lower than in any year, unaffected by industrial disputes, since 1859. Eighteen-fifty-nine is a good long while ago, but "Marksman" fancies that his father once remarked how bad trade was in that year. The country at the time was still suffering from the aftermath of the Napoleonic wars, which, apparently, were waged while the country was barely recovered from the effects of the Norman invasion. And as a little piece of information exclusive to readers of The Foundry Trade Journal, "Marksman" can assure you that the Normans would never have conquered the country had it not been crippled by the long guerilla warfare against the Romans!

* * *

The feast of the Cutlers' Company of Sheffield in 1960 is bound to be a memorable occasion. It is then that an authentic account of the discovery of stainless steel will become available. At present the account is contained in a sealed envelope which the discoverer, Mr. Harry Brearley, has given to the Company with the stipulation that it is not to be opened until the time mentioned above. Longevity has never been one of "Marksman's" obsessions, but such is his curiosity!—he means to live until 1960 expressly to learn the Truth about the Discovery of Stainless Steel.

* * *

A London club of lightsome spirit is approaching members for their subscriptions thuswise; "Uneasy lies the head that owes a crown Help the Defence Fund. Relieve your conscience of your Subscription. Pass your hat for our credit's sake and pay, Pay! PAY!" The club in question is *not* the Athenæum.

Marksman.

Notes from I.B.F. Branches.

Birmingham.—The annual dinner of the Birmingham, Coventry and West Midlands Branch will be held on Saturday, February 20, at the Imperial Hotel, Birmingham, at 7.15 p.m. Ladies are invited. The Branch-President (Mr. F. J. Hemming) will be in the chair, and the President of the Institute (Mr. A. Harley) will be present. Tickets may be obtained from Mr. F. K. Neath, B.Sc., hon. secretary, at 24, St. Paul's Square, Birmingham.

Sand Testing in the Foundry.*

By Wm. Y. Buchanan.

The title "Sand Testing in the Foundry" has a special significance, as it is intended to present the subject from the point of view of the man on the job, whose time is already fully occupied, and hence any form of sand testing likely to become a further part of his daily routine must necessarily be clear, concise and quite free from any doubt which may result in unnecessary duplicating before conclusions can safely be drawn. The following notes may be of interest at the present time in view of the fact that the official adoption of the compression and permeability tests by the Institute of British Foundrymen is under consideration. These two tests seem sufficient for foundry testing; other methods, such as elutriation, sieve-testing and others, are not referred to here.

Sand-treatment experiments were first started to try out the claims of the British Cast Iron Research Association with regard to economy in new sand and improvement in quality of facing sand, and it is gratifying to note that these claims have been justified to a surprising degree. A short description of these experiments in sand milling will show this clearly.

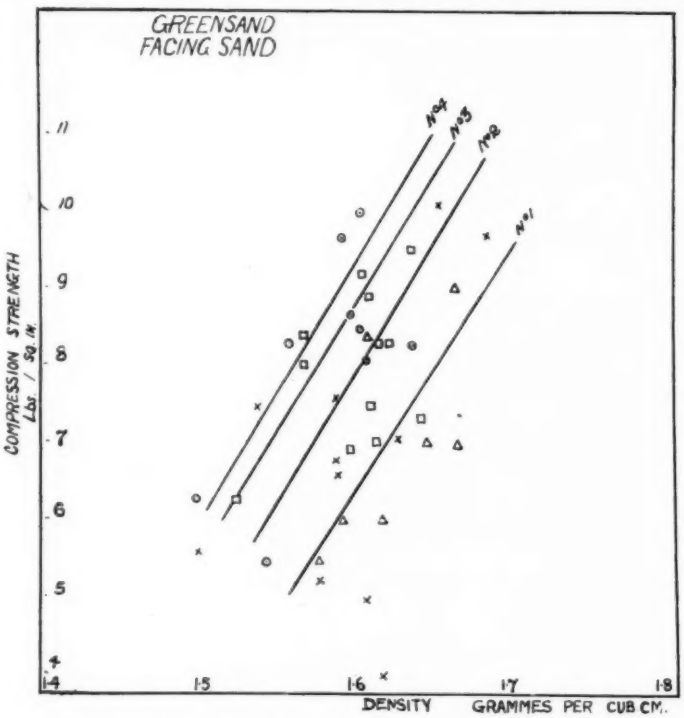

FIG. 1.—INFLUENCE OF MILLING ON COMPRESSION STRENGTH.

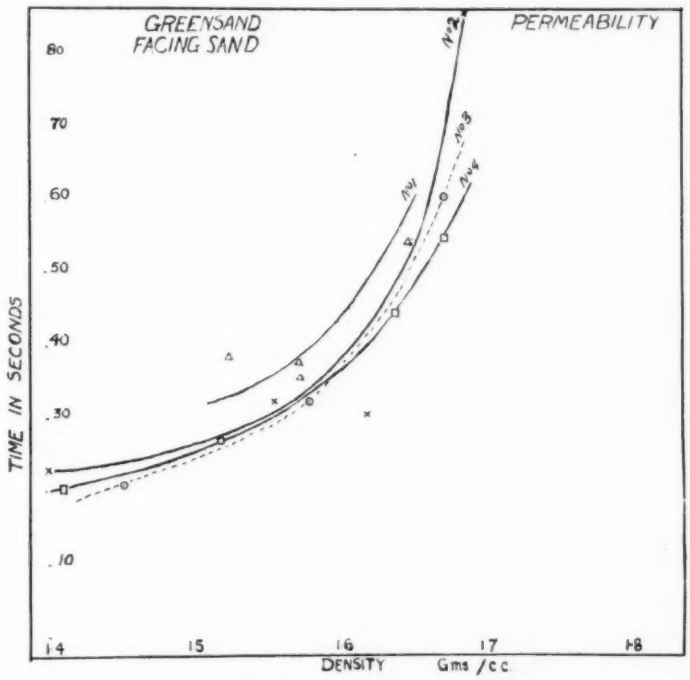

FIG. 2.—INFLUENCE OF MILLING ON PERMEABILITY.

PISTON BODY & COVER.
MADE IN GREENSAND.

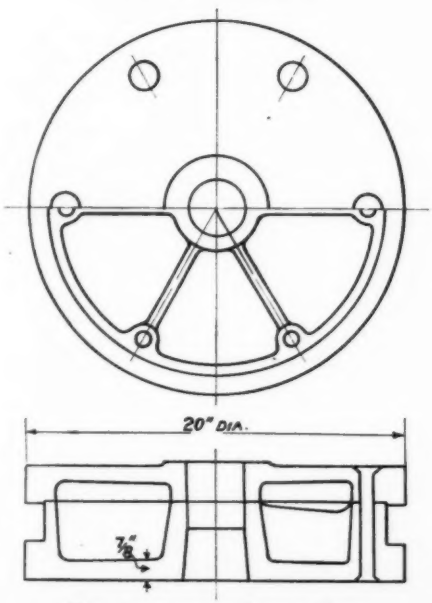

FIG. 3.—TYPE OF MOULD USED.

* Paper read before the Scottish Branch of the Institute of British Foundrymen, Mr. N. McManus presiding.

Milling Experiments.

The existing sand practice at the time these experiments in milling were carried out in green sand was as follows:—A mixture of 30 parts floor sand, 6 parts new rock sand and 4 parts coal dust was heaped up in alternate layers, cut vertically with a shovel, turned over and put through ½-in. riddle. It was then sifted through a ¼-in. sieve to the usual thickness round the pattern and the mould rammed up with floor sand in the usual way.

In order to carry out milling tests a mortar mill was temporarily adapted so that the rollers could be lifted by overhead tackle. The rollers were hoisted 2 in. above the bottom of the pan, the mixture (30 parts floor sand, 3 parts rock sand and 4 parts coal dust) was shovelled into the mill. Samples were taken: (1st) when the sand had just been mixed; (2nd) when it had been milled for 5 minutes; (3rd) after 10 minutes' milling; (4th) after 15 minutes' milling. The sand was broken up in a disintegrator and was ready for use.

The graphs (Figs. 1 and 2) show that after 10 minutes' milling a 50 per cent. increase in strength was obtained and an increase in permeability and only half the usual quantity of rock sand used.

The sand was used in moulding a sand coupling. The pattern drew perfectly and the resulting casting showed very fine edges and better skin than usual. The sand in the holes was reinforced with one sprig only. The experiment was repeated throughout with much the same result—*i.e.*, 50 per cent. saving in rock sand, 50 per cent. increase in strength, and quite an appreciable increase in permeability.

The sand was again tried out in a mould; this time for a piston cover of the form shown in Fig. 3. The previous moulding time was reduced by about a half, as the mould required less repairs and was made without sprigs or venting. The metal was cast hotter than usual and the resultant casting had good edges and surface. Many other experiments were carried out but the figures just given were not improved upon. From Table I it will be seen that even with the rollers running fairly near the pan, no crushing of the sand grains is evident.

TABLE I.—*Mortar Mill with Rollers Raised. The Effect of Milling on the Fineness of Green Sand.*

Per cent. on 20 mesh.	Per cent. on 40 mesh.	Per cent. on 60 mesh.	Per cent. on 90 mesh.	Per cent. under 90 mesh.	Per cent. fineness.	Per cent. moisture.	Milling time.	Height of rollers.
15.5	12.7	29.3	19.0	13.5	56.4	9.0	5 min.	2 in.
13.7	17.8	31.2	16.0	13.5	56.5	8.7	10 „	2 „
13.7	18.7	28.0	17.7	13.7	56.7	8.2	15 „	2 „
17.2	13.1	24.0	19.7	15.2	56.0	9.0	5 „	1 „
15.0	17.0	29.5	18.5	11.0	55.0	8.3	5 „	½ „
Hard Cake taken from Bottom of Pan.								
12.0	20.0	30.0	17.0	12.0	55.7	9.0	20 „	½ „

Criticism of Compression Strength Test.

The standard B.C.I.R.A. compression strength and permeability apparatus was used in carrying out these tests, and the main object of this Paper is to put forward some short methods which do not involve any change in principle, but in the method of preparation of the test-piece before testing. The compression strength test-piece or core, being very small, was found to be the most difficult to produce. The cores always seemed to fall within a short range of densities and the difference in strength between tests of the same density often very high. Also the large number of tests done on any one sample did not give results in keeping with the time required.

In order to increase the range of these tests, rammers of different weights were made of the shape shown in Fig. 4. It was hoped to produce cores of densities varying from very lightly rammed to heavily rammed, but the results were disappointing. The cores made by hand ramming were found to break readily in removing the core box. It was then decided to try making cores by squeezing in a modified core box and the first trial gave two tests the same, one within 1/10 lb. of these and a fourth within 3/10 lb. in the dry-sand sample already tested by hand ramming. These are set out in Fig. 5.

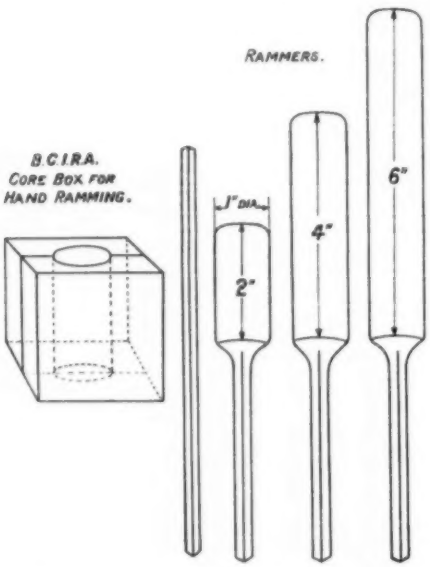

Fig. 4.—Type of Rammers Used for Compression Tests.

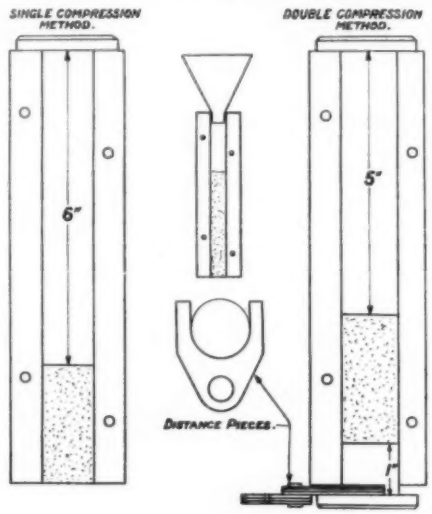

Fig. 6.—Methods Used for Making Sample Cores.

Compression Methods for Making Test-Pieces.

The core box was made 6 in. longer than required and a good fitting plunger made to fill the 6 in. extension as shown in Fig. 6. The quantity of sand is first weighed out to correspond with the density required in the finished test-piece, transferred to the core box by way of the funnel, and the plunger pressed down to give the core its finished size. For most useful densities the plunger can be pressed down without mechanical aid, but any convenient form of lever or screw such as the compression testing machine may be used if necessary. This method is referred to hereafter as the single compression method. Some experiments were carried out on the effect of compressing the core from both ends. The first tests were done by putting a washer or distance piece of a definite thickness under the head of the plunger so as to stop the compression before it was complete, the box was opened and the core reversed and the compression completed on what is normally the bottom end of the core. This method is hereinafter referred to as the reversed method.

In reversing the core, care has to be taken to see that sand does not prevent the box from closing, as the partly-closed box does not support the core during the remainder of the compression operation and a slightly strained core results. The ill effects of this are most noticeable in dry sand tested in the dry state. Hence when the core is made as shown in the right-hand part of Fig. 6 this defect is removed. The distance piece is placed in position as shown, under the bottom of the mould, and after filling the mould the 5-in. plunger is pressed down. By turning the mould bottom up, removing the distance piece and pressing down the 1-in. plunger the double compression will have been effected without removing the core. This method, referred to as the double-compression method, is as quick as the single-compression method and produces perfect cores. The distance piece consists of some six or eight pieces

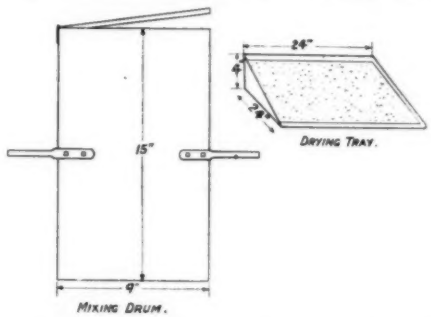

Fig. 7.—Showing Drum Used for Mixing Sand Samples and Tray for Ensuring Proper Sampling.

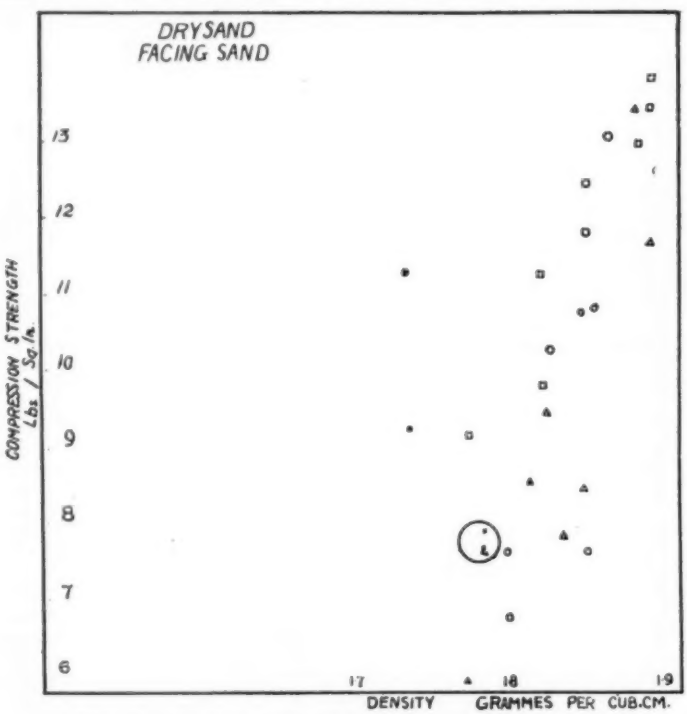

Fig. 5.—Showing Concordance of Results when Samples are Squeezed.

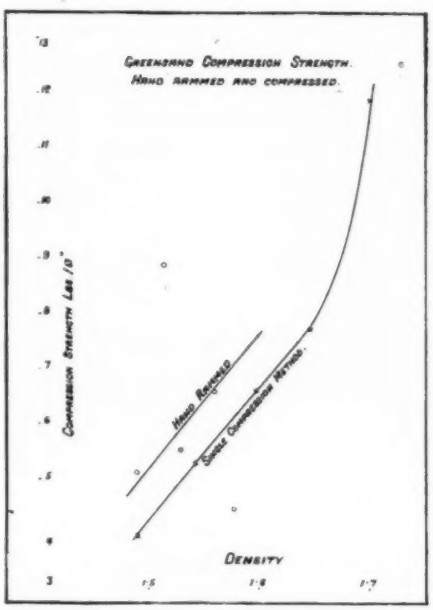

Fig. 8.—Showing that Hand-Rammed Tests give Higher Compression Results than Single-Compression Tests.

of iron $\frac{1}{16}$ in. thick, so that the number of these used can be varied as required.

Other possible causes of bad results in tests shown so far were thought to be: (1) Variation of the sample during casting and (2) variation of speed of loading the test-piece.

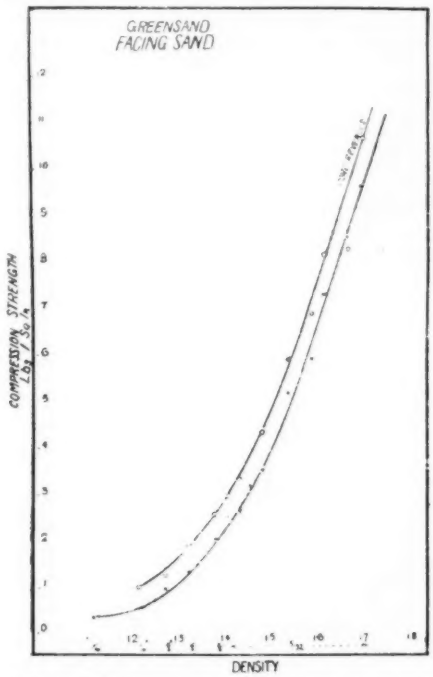

FIG. 9.—SHOWING THAT SQUATTING DOES NOT ALTER SHAPE OF GRAPH.

Treatment of the Sample.

The samples were always taken in airtight tins 6 in. dia. and 9 in. deep, and these were kept closed. When required for testing, the sand was passed through a $\frac{1}{8}$-in. sieve and transferred to the mixing drum shown in Fig. 7. By holding one trunnion or handle and resting the other on a low bench the drum was easily revolved so as to turn over the sample. The sand was well mixed before testing and turned over between each test, the lid being kept tightly closed except when sand was being removed. This drum effectively cured the troubles arising from drying of the sample during testing.

The tray shown was used to prepare sand for carrying out tests on the effect of variation of moisture content. The sand was in the form of a wedge, and so the portions taken from this by cutting vertically, beginning from the thin end, gave gradually increasing moisture contents. In this way a number of samples having a variety of moisture percentages sufficient for the complete tests can be obtained after two or three hours' drying in a warm room. This was found to be much better than such methods as mixing dry sand and water, dry sand and wet sand, testing and drying alternately, and so on.

Rate of Loading the Test-Piece in the Compression Test.

To investigate the effect of variation of uniform rate of loading a pendulum was used. Taking an elevation view of the handwheel of the compression testing machine, a point in the revolving wheel appears to move from side to side in the same way as the bob of a swinging pendulum. By keeping this point in the wheel moving directly under a swinging pendulum a uniform rate of loading was obtained. The length of the pendulum was changed and a series of results obtained. Table II shows that the rate of uniform loading of the test-piece does not make any visible difference to the compression-test results.

TABLE II.—*Effect of Variation of Uniform Rate of Loading in Compression Test. Weight of Test Cores 59 gms.*

Turns of loading screw per sec.	Green sand, lb. per sq. in.	Dry sand (green state), lb. per sq. in.
1.76	5.0	—
1.20	5.6	3.1
1.03	5.1	3.2, 3.4, 3.2
0.94	5.6	3.3, 3.1, 3.1
0.84	5.9	3.1, 3.2, 3.4
0.73	5.6	3.3, 3.0, 3.3
0.62	6.0	3.1, 2.9, 2.9, 3.1
0.51	—	3.3, 3.1, 3.3
0.06	—	3.1, 2.9

Comparison of Hand-Rammed and Compression-Made Cores.

The hand-rammed tests are shown in Fig. 8 to be stronger than cores made by single-compression method. It was thought that the necessary skill had at last been acquired, as hundredweights of sand had been turned out in the form of test-cores between the time of making the hand-rammed cores shown at the beginning of the Paper and those now under consideration.

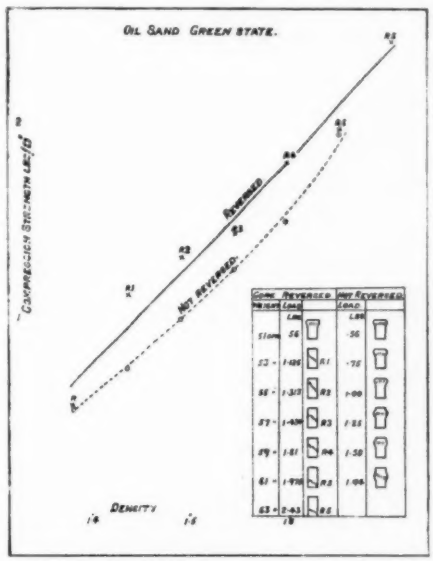

FIG. 11.—SHOWING THAT THE REVERSED METHOD YIELDS BETTER RESULTS.

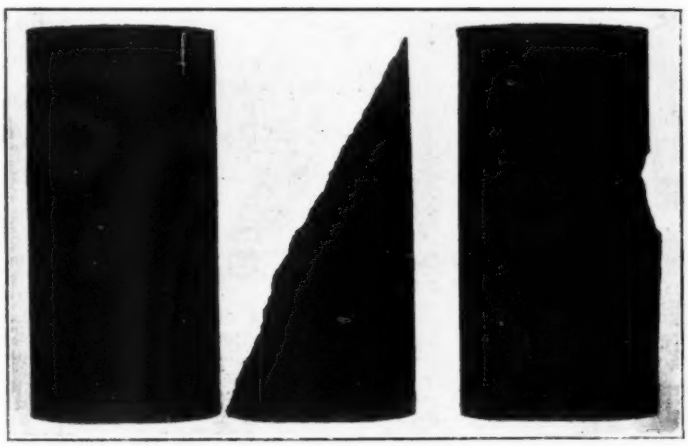

FIG. 10.—SHOWING FRACTURES OF SAMPLES WHEN USING THE REVERSED METHOD.

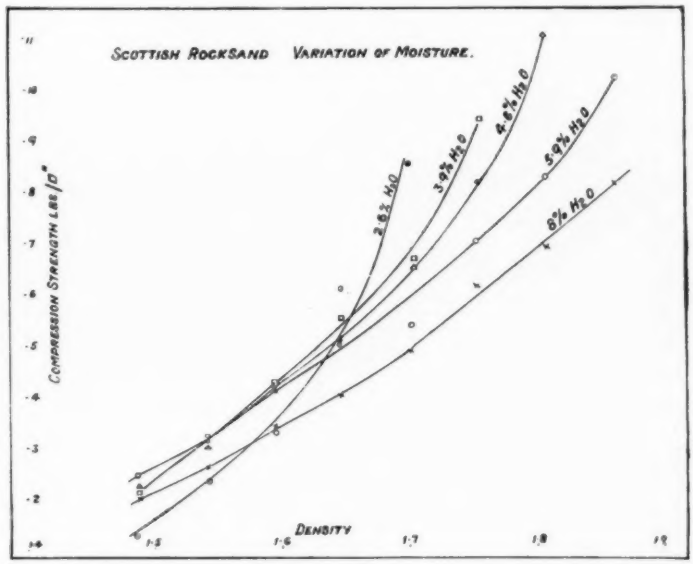

FIG. 12.—INFLUENCE OF MOISTURE ON THE STRENGTH OF ROCK SAND.

The green-sand tests were carried out without the use of the mixing drum, and the dry-sand test done with the drum in use; the improvement in the results is clearly shown. Thus the use of the squeezing methods of making the test-piece in conjunction with this mixing drum makes the whole test quite free from personal skill, and specific instructions can be given to an assistant on how to obtain this accuracy. Further, when undue variations occur under this method lack of uniformity of the sample is definitely shown. The spring balance supplied for the compression test would be much more convenient if fitted with a loose indicator as shown in the original B.C.I.R.A. illustration.

However, the second example, which was done at the same time, shows the same irregular results. The original intention with regard to the single-compression method was to use it for tests at one density only in order to eliminate the necessity for making a graph and thus complete the test in a much shorter time, using it for daily routine tests.

The single-compression method was known to give test-pieces having soft corners at the lower end at some densities, and so, to investigate this, the shape of the fracture was carefully noted in tests made by "single compression" and also by "reversing" in various types of sands.

In green sand, squatting or bursting was

observed in all single-compression tests (Fig. 9) except those above 1.5 density, but the cores withstood handling at a density as low as 1.12 and strength of 4 ozs. per sq. in. The bursting tendency does not alter the shape of the graph. Tests made by "reversing," using a suitable thickness of distance piece, gave cores of the perfect fracture such as shown in Fig. 10.

Oil sand was tested in order to observe the effect on a finer-grained sand, and, as shown in the table of Fig. 11 all single-compression tests spread out, while reversed cores slit in the proper manner, giving higher results. The figures R_1, R_2, etc., refer to the number of leaves of the distance piece used, each being $\frac{1}{16}$ in. thick.

The tendency of dry sand to form a hard shell on the "single-compression" made cores, when tested in the dry state, has a marked effect on the results, especially when the moisture content

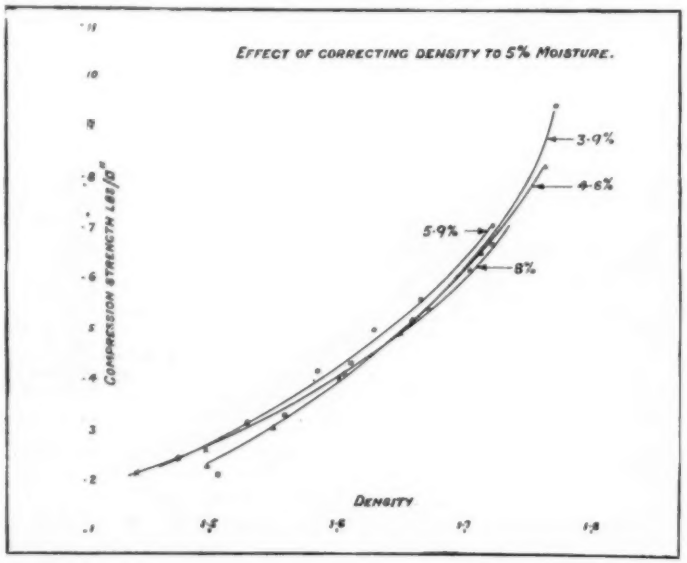

Fig. 13.—Influence of Correcting Density to 5 per cent. Moisture Content.

is high. This skin effect, which also affects hand-rammed cores, causing excessive breakages in removing the core from the core box, is due to the surface of the mould becoming wet with bonding material, and the excessive friction resulting during the actual compression sleeks the surface, principally at the top end, causing a strong shell there.

If the mould be rubbed with a dry cloth this effect is removed. The test carried out on dry sand, dry strength, show that single-compression tests crumbled and gave very much lower results than the reversed cores, which broke with the correct fracture. Oil sand in the dry state showed that single-compression test crumbled at the bottom, whilst the reversed cores slit as before.

From the foregoing tests it is seen that cores made by "reversing" are equal to the ideal hand-rammed tests, and the double-compression method has the advantage of the speed of the single-compression method with the accuracy of the reversed method without being subject to the possibility of straining if the box is not closed properly.

Moisture Content.

In all graphs shown so far the "apparent density" is the foundation on which the tests are built up, and by definition this is "weight of sand per unit volume." In the case of perfectly dry sand an increase in weight means an increase in quantity of sand per unit volume or an increase in degree of ramming. If, however, this unit volume of dry sand is moistened there is an increase in weight, hence an increase in apparent density without any change in the degree of ramming.

The B.C.I.R.A. example shows that green sand is strongest at 5 per cent. moisture and that the strength falls off with higher moisture, *i.e.*, that greatest strength was obtained from green sand "which most moulders consider on the dry side." This did not agree with the author's experience in practice.

A sample of rock sand examined showed an increase in strength from 8 to 5 per cent. moisture over the full range of densities, and under 5 per cent. moisture the graph (Fig. 12) began to tilt sharply, giving higher strength at high densities and lower strength at low densities.

When the weights of the test-cores were corrected to the weights they would have at 5 per cent. moisture, and the densities obtained from these weights plotted, the marked difference in strength disappeared, as is shown in Fig. 13. An example of green sand showed the same thing, one graph being roughly common to all points after correcting to 5 per cent. moisture. A further example in green sand again showed that

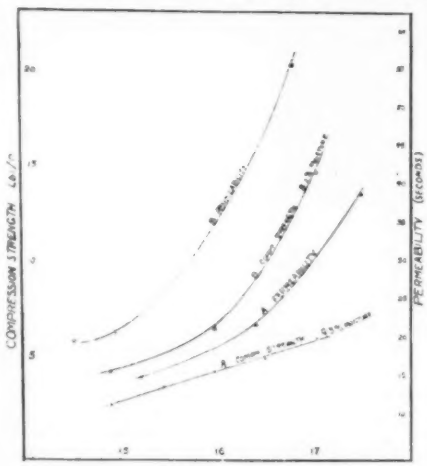

Fig. 14.—Showing the Practical Utility of Sand Testing.

on calculating the densities to 5 per cent. moisture the difference in strength disappears. Thus for the same "degree of ramming," as distinct from apparent density, a moulder will get as much strength from 8 per cent. moisture as from 5 per cent., while 8 per cent. moisture makes the sand much easier to work in finishing moulds. As a practical illustration of this effect the following example may be taken: A complaint was received of a quantity of floor sand received from the dressing shop. This sand was thought to be burnt and to have lost its bonding power, as judged by the usual practical method. At first sight the curve A (Fig. 14), representing facing sand made from this lot of floor sand, shows a marked difference in strength from a normal quality in graph B. These curves resemble the case just stated, and the low strength in this case is due to excessive moisture effect on the apparent density. The sand from the dressing shop would no doubt be very dry, so that the moisture would not have time to soften the clay bond and the sand would in this state show low bond strength.

(To be continued.)

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

A Paper "Wangle."

To the Editor of The Foundry Trade Journal.

Sir,—Under the above heading are two surprising statements in your last issue, the first by Mr. V. Jobson, of Qualcast, Limited, Derby, who makes the assertion that only virgin pig is used—"they cannot afford to buy scrap and jeopardise the quality of their product." Now good machinery scrap can be purchased at several shillings per ton cheaper than No. 3 pig, no small consideration to firms using large quantities annually, and under proper control is equally dependable (why should it not be?). Surely melting or refining, and manufacturing into high-class products is one proof of quality; analysis, where possible, can then do all that is necessary.

I should quite agree with Mr. Jobson, however, that the price of his domestic scrap is equal to pig-iron in such circumstances.

The second statement is more surprising still and can unhesitatingly be described as ridiculous, that of Mr. T. H. Gray, in which he says "there is not a foundry in this country that can give a true 'cost-of-metal-at-the-spout-figure,'" etc.

Quite recently I have given lectures at Birmingham and Newport in which the whole working costs from raw material to finished casting were produced and shown; these are actually in your possession, Mr. Editor, to judge for yourself.

Any firm who can or does ignore such items as cupola bricks are better out of the business, and if they pay 5s. and more per load for "carting" five loads per day they should see a doctor before it becomes necessary to see their solicitors.

The pleasure of passing from the ridiculous to the sublime of Dundydan is emphasised in his one sentence: "the output of *good castings* should form the basis on which to express this cost." Here in a nutshell is condensed wisdom.—Yours, etc.,

G. Moran,
Manager.

The Reliance Foundry Company,
Birmingham Street, Kings Hill,
Wednesbury.
February 8, 1932.

[This letter has been slightly condensed.—Ed.]

During January only one cargo of foreign ore arrived at the Prince of Wales Dock, Workington, and the imports for the month were 6,033 tons, compared with 11,200 tons last December and 9,000 tons in January, 1931.

Manufacture of Chrome-Iron Alloys.

"WILD" DIRECT-REDUCTION PROCESS.

Although chromium was first alloyed with iron upwards of 100 years ago, it was not until a much later date that definite and indeed rather extraordinary corrosion-resistance was noted. Scientific investigation established that such resistance to corrosion, whilst not a direct function of the carbon content, was much influenced by it. Research also proved the tremendous possibilities of two definite chrome-iron alloys, viz., low-carbon and higher carbon chrome-irons now commonly known in the industry for want of better terms as rustless iron and rustless steel (under 0.10 per cent. C. and about 0.30 per cent. C. respectively). The chromium was introduced to the iron as ferro-chrome, an alloy which contains in some of the lower grades up to 10 per cent. of carbon, although it is now possible to produce an alloy almost carbon-free. Unfortunately the lower the carbon content, the higher the price—a fact which rendered the production of low-carbon chrome-iron very costly.

In view of that fact, various attempts have been made from time to time to dispense with the ferro-alloy and reduce the chrome ore direct into the iron. Early attempts, like most other pioneer efforts, were only partially successful. A process, however, perfected by Ronald Wild of Sheffield, has met with much success, and is now a commercial proposition.

Without any sacrifice in quality, indeed in some respects the quality is enhanced, the "Wild" process has brought down the cost of production to that of the raw materials, plus the cost of only one furnace operation, whilst the output is remarkably high even from the view of regular steel-making practice.

The sole manufacturing rights, for Great Britain, of rustless iron by the "Wild" chrome-ore direct-reduction process was acquired by the Darlington Rustless Steel & Iron Company, Limited, of Darlington, in September, 1930, though the company under its present style was not formed until April 17, 1931, when Mr. J. Lloyd Bentley, F.C.S., F.Inst.F., became managing director. Mr. Bentley has, as many of our readers are aware, spent the whole of his working life in the steelmaking industry. He has also a particularly intimate knowledge of the "Wild" process, as, by invitation, he helped in the development of that process in the United States, finally taking over the management of the plant. He was thus able, at the expense of the parent company, as it were, to overcome the difficulties and troubles which are always incidental to the perfecting of a new process on a commercial scale. That Mr. Bentley turned the experience so gained to good account is evident from the fact that since the starting of the Darlington Works production has proceeded without a single hitch, and the product proved equal to the initial high standard demanded.

The new company were fortunate in being able to acquire the Alliance Works, Albert Hill, Darlington, which, formerly in the occupation of the Blake Boiler Company, are about a mile out of Darlington, the works sidings connecting up with the main line of the L. & N.E.R. The works comprise a building 530 ft. by 120 ft., which is covered by two bays, lofty and well lighted, with a bay in the mid position and at right angles to the main shops of 45 ft. span. There were a number of auxiliary buildings, the whole being fronted with a substantial block of offices. As the actual area acquired is 6¼ acres, there is ample space for future extensions.

For the most part it was merely necessary to recondition the buildings and to dismantle a number of the small shops, so that the work of installing the manufacturing plant could be proceeded with immediately the works were taken over. The two bays are laid off as furnace and stocking bays respectively, the former being served by a Booth 20-ton overhead crane and the latter by a 10-ton Booth crane. Standard rail track runs across one end of the shop, thus affording easy facilities for discharging the raw and loading up the finished product. Raw materials are stocked immediately adjacent to the furnace, and the ore is broken down in an Edgar Allen crusher prior to mixture with the ferro-silicon for charging to the furnace. The crushing of the ore is, however, a temporary expedient. With a view to putting the works on a productive basis with the least possible delay, Colonial ore had perforce to be purchased, and considerable stocks are remaining to be dealt with. When, however, the concentrates are available, the crushing plant will be put out of commission, and thus the process be eliminated. Hitherto chromium has in the main been imported from Rhodesia, where, however, the value of the rich deposits are to some extent negatived by the high costs of transport over a difficult country.

Supplies of chromium are, of course, a first essential for the Darlington Company, and there are very obvious advantages in controlling such supplies and thus making the works independent of outside sources. The chromium deposits of California have been well known for a considerable number of years, but hitherto for reasons into which in this article we need not enter, but which are well known to all consumers of chromium, no serious attempts have been made to develop them. The Darlington Company were fortunate in being able to acquire extensive mineral rights in California extending to upwards of 1,560 acres. It may be interesting to note that 30,000 tons of high-grade chromium ores were mined from a portion of this property in 1918. The property is situated some 30 miles from Sacramento, approximately 120 miles from San Francisco Bay and about 9 miles from the nearest railhead, which is at Folsom. Excellent roads connect the mine to the railhead, and it has been found after careful investigation that

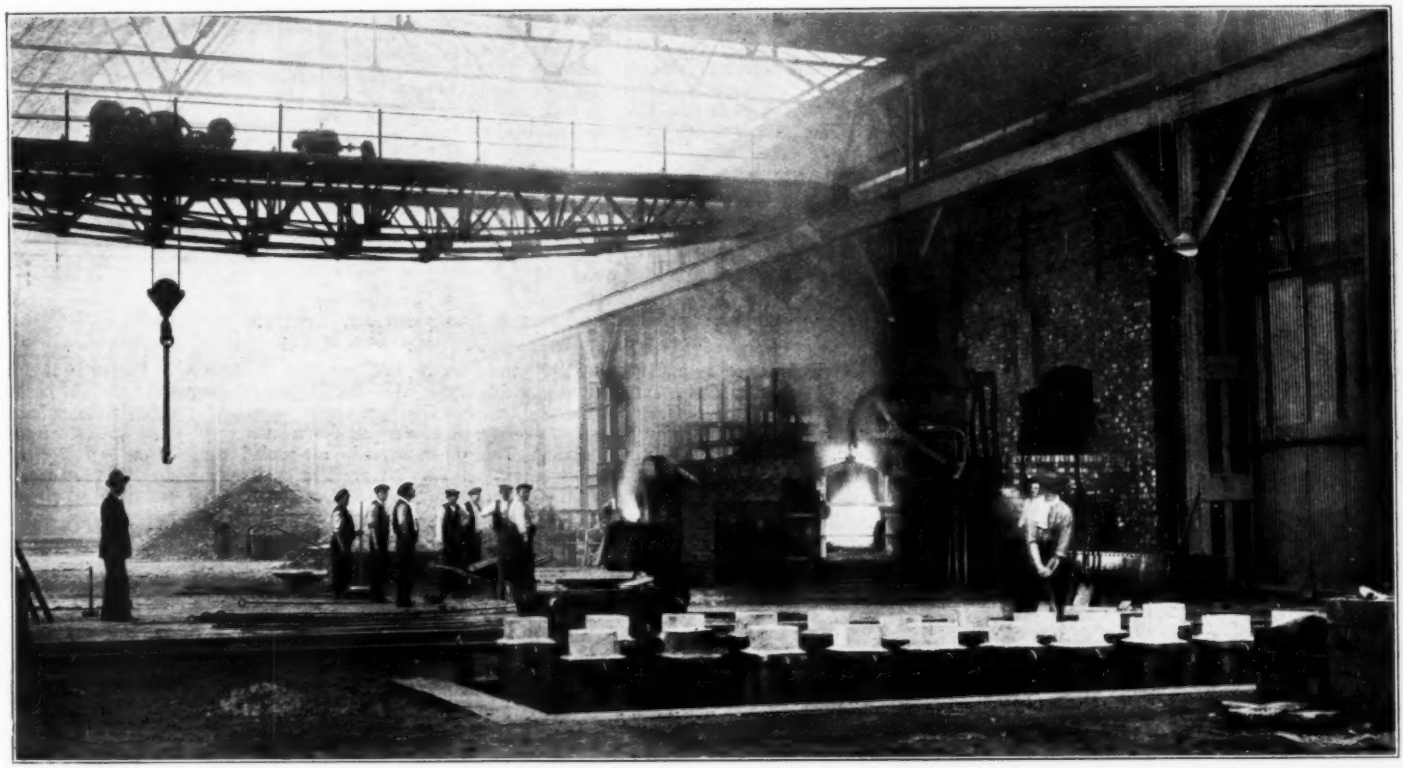

FIG. 1.—VIEW IN THE MELTING SHOP OF THE DARLINGTON RUSTLESS STEEL & IRON COMPANY, LIMITED.

the most economical method of bridging the distance from mine to rail was road transport. The ore is shipped as 54 per cent. concentrates. The estimated yield of the property is 750,000 tons, which is equal to 2,000,000 tons of mine ore. The immediate equipment of the mine provides for the production of 30,000 tons of concentrates per annum, and, as the present demand of the Darlington works does not exceed 6,000 tons per annum, it will be seen that the output of the mine will meet a five times extension of the furnace plant at Darlington, over a period of 25 years.

transport to this country have been arranged. The property is, of course, very conveniently placed in regard to American consumers of chromium, and it may be noted that the importation of chromium ores into the United States last year amounted to no less than 300,000 tons.

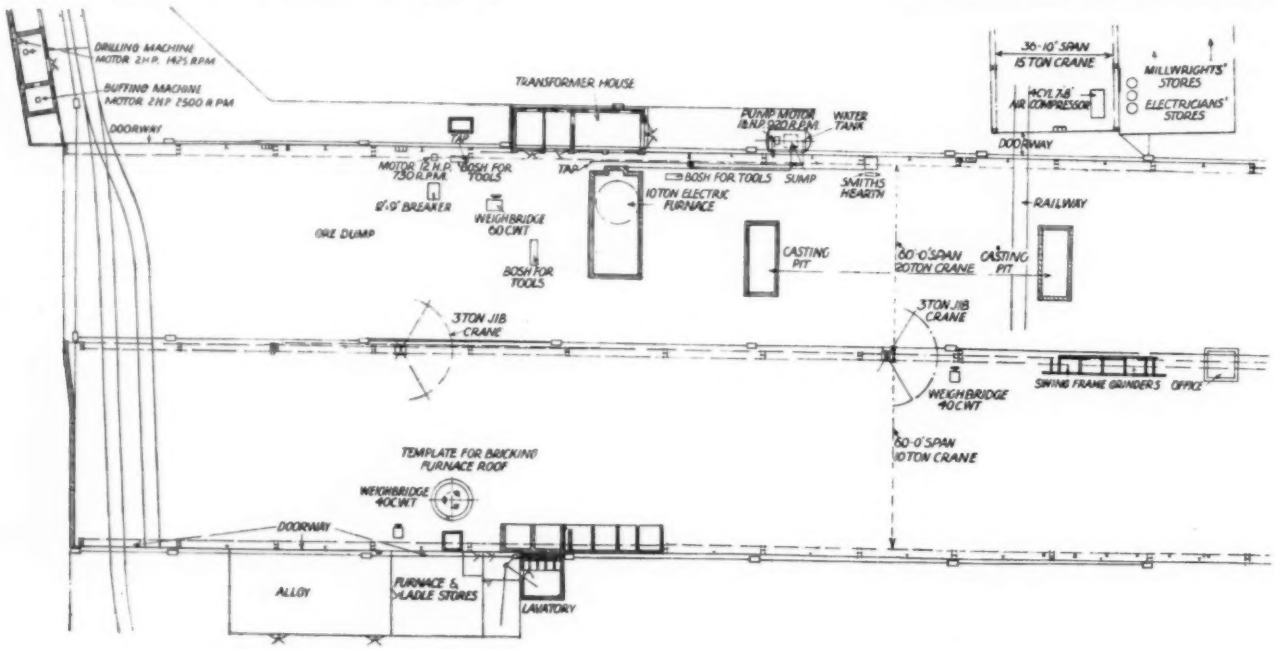

FIG. 2.—LAY-OUT OF THE WORKS OF THE DARLINGTON RUSTLESS STEEL & IRON COMPANY, LIMITED.

The electric furnace is a Héroult of 10 tons capacity and able to give in ordinary steel-making at least five charges per 24 hrs. with a current consumption not exceeding 650 kw.-hr. per ton of steel produced. The rocking motion is hydraulic, the power being supplied by a motor-driven pump at 150 lbs. pressure. This, we believe, is the first furnace to be equipped with electrically-operated hydraulically-controlled electrodes in this country on the Tagliaferri principle, and in practice it has given perfectly smooth operation. Two turbine pumps, one a standby, deliver water at 70 lbs. pressure for operating the electrodes. The system of regulation comprises a combined hand and automatic-regulator and hand-regulation devices for the commutation of automatic regulation to hand regulation.

The various measuring and recording instruments are mounted on a panel. Power is taken from the Darlington Corporation and brought to the furnace sub-station at 6,000 volts, where it is stepped down in a three-phase transformer, oil-immersed, air-cooled and of a capacity of 2,700 k.v.a. The primary connection is mesh and the secondary star, with switches on the primary which permit voltage variations in the secondary of 190-125-110 volts. The switch is of the three-pole oil-immersed automatic type, with two relays for maximum load, which can be regulated and a relay for minimum voltage.

FIG. 3.—TAPPING 10-TON ELECTRIC FURNACE.

FIG. 4.—VIEW OF ANNEALING FURNACE.

Pending such developments, however, there is no doubt whatever that a ready market will be available for the surplus. The Californian ore is low in silica, and readily lends itself to concentration—two very important considerations, and further, very advantageous rates of

Remote control is also provided for by a button placed on the instrument panel. The furnace lining appears to be standing up remarkably well; the life of the roof is from 50 to 60 heats, the life of the lining being no less than 100 heats by the "Wild" process; needless to say a spare roof is kept as a standby.

The ingots cast range from 11 to 35 cwts. and two ingot pits are provided, a comparatively small head is employed, and the ingots are remarkably free from piping. Shop auxiliaries include a battery of swing grinders for cleaning up the surface before rolling and a number of pneumatic chipping hammers.

For the time being the Darlington Works are manufacturing rustless iron of four grades, as shown in Table I.

To obtain full corrosion resistance with "Defirust" proper polishing is essential. It may be rolled, pierced and forged, and responds to hardening, tempering and drawing, and is subject to air hardening. It can be cold rolled, cold drawn into wire, deep drawn, bent, formed and upset, and may be easily machined with properly-designed tools.

The "Special Defirust" is highly corrosion-resistant without polishing, and it may also be used continuously for higher temperatures than "Defirust," the comparison being as 650 to 540 deg. C. It does not respond to heat-treatment beyond normalising after cold-working. In cold-working it will slightly work-harden, it has

TABLE I.—*Composition of Special Grades (per cent.).*

Brand.	Defirust.*	Special Defirust.*	Defistain.†	Defiheat.‡.
Chromium ..	12 to 14	16 to 18	17 to 19	25 to 30
Carbon	less than 0.10	0.10 max.	0.06 to 0.18	0.20 to 0.25
Silicon	under 0.75	0.75 max.	0.75 max.	0.75
Nickel	Trace	Trace	7 to 9	Trace

* This grade is magnetic. † This grade is non-magnetic.
‡ This grade is ordinarily magnetic.

also a low impact value which renders it unsuitable for sections subject to shock.

"Defistain" has altogether higher resistance to corrosion than the last-mentioned, and may be continuously used at temperatures up to 870 deg. C., for the rest its properties are common to those already mentioned with certain reservations. Temperature range is very small, as it work-hardens progressively below 1,000 deg. C., but it does not air-harden. It is extremely tough and not so easy to machine as the first two-mentioned brands.

"Defiheat" has a resistance to corrosion slightly higher than "Defistain," combined with much greater heat resistance, and may be continuously used up to 1,200 deg. C. The temperature range is, however, very small, and heating must not be carried above the temperature stated. Cold work must be done with certain precaution, as the material does not respond easily to excessive work. Machining is possible, though not easy, and, whilst tough in the softened condition, it is subject to brittleness if not properly treated.

The whole of the brands lend themselves to the welding process, though such work, more particularly in the case of the "Special Defirust," calls for considerable experience; on the other hand, "Defistain" lends itself easily to welding by any method, whilst the properties of the weld are wholly satisfactory.

The high-chromium content of "Defiheat" made by the "Wild" direct-reduction process shows the most substantial saving against the ferro-chromium addition method.

In the past chromium contents over 25 per cent. in chrome-iron alloys without the addition of nickel had a very limited field, due to great difficulties in their fabrication, especially their brittleness. Most of the specifications for material to be used for the above-mentioned applications demanded an addition of nickel varying from 8 to 60 per cent. This necessity has been overcome.

"Defiheat" rustless iron does not require any addition of other alloying metals. It can be successfully fabricated into any shape and shows higher corrosion resistance than if nickel is added.

The auxiliary shops comprise stores for bricks, alloys, etc., electrician's shop, millwright's shop, etc. The works sub-station is provided with Reyrolle switchgear. The incoming current at 6,000 volts passes so far as the furnace is concerned direct to the furnace sub-station, and for the auxiliaries it is stepped down to 400 volts in two Met-Vic transformers. The crane motors are supplied through a rotary converter. Pneumatic power is supplied by a Broom & Wade compressor at 100 lbs. pressure, which is driven by a 52-h.p. motor.

For the time being the company's activities are confined to the manufacture of the rustless alloys; but the demand for highly-finished sheet to accurate gauge will shortly be met by the Darlington Works. The company have placed an order with Messrs. Fraser & Chalmers Engineering Works for a Bliss cluster mill, a mill which represents the latest practice in the cold-rolling of sheets, and embodies some entirely new features in rolling-mill construction and practice. Indeed, the Bliss mill may well be described as a precision tool.

The bay at right angles to the main shops, to which reference has already been made, is being made ready for the reception of the mill. It forms an ideal shop for the purpose, and is very conveniently placed in relation to the works generally.

The Use of Flexible Couplings in Foundries.

By "KILOWATT."

Broadly speaking, the object of a flexible coupling is to ensure as far as possible perfect alignment between machine, shafting and prime mover, incidentally taking up wear in bearings and to absorb shock and stress. Experience has proved that an appreciable percentage of power generated is lost between prime mover and machine due to malalignment, and in order to reduce this loss to a minimum, suitable flexible couplings are introduced. It is common practice, when a motor of economical speed can be obtained, to match the speed of the driven machine to couple the motor direct to its load, and, if machine and motor could be maintained in nearly perfect alignment, solid or rigid-flanged couplings would form an ideal connection. Such an achievement, however, is not only difficult to obtain, but practically impossible to maintain.

Obtaining Perfect Alignment.

To obtain perfect alignment, one half of the coupling must be concentric with its shaft and its face at right angles to the shaft's axle. Unless the shaft and couplings are carefully machined as a unit after they are assembled, it is almost impossible to obtain the foregoing conditions. When keying the coupling to the shaft, it is likely to be distorted from true alignment. In that event, there may be an error in alignment that cannot be corrected by locating the motor. The two halves of the couplings may be aligned perfectly, but the axis of the shafts will not be in line. Even when the motor can be properly aligned with its load, settling of the foundation, distortion of the bedplate, wearing of bearings and other causes may throw the machine out of line.

When two shafts that are out of line are connected by rigid couplings, severe bending stresses are set up in the shafts. For each revolution the shafts pass through a complete cycle of tension and compression stresses. At 1,200 r.p.m. a motor's shaft in eight hours will make over one-half million revolutions. Unless this motor is perfectly aligned with its load, their shafts will be subjected to over one-half million bending cycles per day of eight hours. From this it is readily seen that such a condition is likely to fatigue the metal in the shafts and cause breakage. Misalignment of shafting connected by rigid couplings has a bad effect on bearings. Lubrication is made difficult, heating and excessive wear result, and the power consumption is necessarily high. Another objection to a rigid coupling is that the rotating element of the motor is not free to seek its true magnetic centre.

Avoiding End Thrust.

Unless the motor is properly located, when the two halves of the coupling are bolted together the rotor of the motor will be out of line magnetically, and this may cause a heavy end thrust. To prevent the foregoing conditions leads to the use of flexible couplings. Machines connected by flexible couplings should be aligned just as carefully as when rigid couplings are used. The purpose of a flexible coupling is not that of a universal joint or to compensate for gross errors in misalignment, as is frequently assumed. Even though some types of flexible couplings may operate considerably out of alignment, they should not be operated in this way, as it subjects them to unnecessary wear. Not only should the machines be carefully aligned, but the alignment should be checked at intervals and corrected if necessary. A flexible coupling should be considered as a machine with moving parts, and, like any machine, if subjected to abuse, increased maintenance, reduced life and unsatisfactory operation may result. A flexible coupling may be regarded as misalignment insurance, a provision to take care of errors in alignment that may develop after the machine has gone into service.

Machines despatched from the manufacturer on a bedplate are frequently assumed to be in proper alignment, and are mounted on their foundation and put into operation without checking. This practice may well lead to machines being placed in service when they are considerably out of line. The alignment of any machine should be checked after its bedplate has been bolted to the foundation.

Where the several parts of a machine operate at different temperatures, a check of the alignment should be made with the machine at operating temperature, and adjustments should be made if necessary. An example of this is a steam turbine-driven generator. Not only does the turbine operate at a different temperature from the generator, but there is a wide range in temperature between the two ends of the turbine, particularly if operated condensing.

When selecting a coupling, the characteristics of the load and the power drive must be considered, along with the rated horse-power of the application. A pulsating load will require a considerably larger capacity coupling for a given horse-power output than is necessary with a constant load. A coupling must be selected for the peak loads to which it will be subjected. This applies whether the load is a constant-torque application or one that is pulsating. Failure to consider the peak loads on the drive has caused many coupling failures.

The speed at which a coupling operates is a factor in its selection and in the amount of misalignment that is permissible. At high speed the coupling must be more nearly in dynamic balance than is required at low speeds. A coupling that may operate quietly at slow speed may be objectionably noisy at high speed. With a given amount of misalignment in slow-speed service a coupling may give long service without failure, and at high speed would have a short life. Couplings can have flexibility in four directions—tangential, angular, radial and axial. Some applications require some of these flexibilities and not the others, although they may not be objectionable.

A coupling should possess at least angular, radial and axial flexibility, and in some cases a certain amount of tangential flexibility. The

(*Concluded on next page.*)

The "Witton" High-Frequency Induction Furnace.

The "Witton" high-frequency induction furnace differs from other high-frequency furnaces in that it is not of the coreless type, but is partially cored. The path for the magnetic field is mainly through thin laminations of high-silicon low-carbon steel. This material has a conductivity for magnetic flux immeasurably greater than that of the air path in earlier high-frequency furnaces. This alloy-steel magnetic path is brought to a central position right inside the axis of the inductor coil. The result is that, instead of a magnetic field weakened by air resistance and uncontrolled as regards its distribution within the crucible, the electro-magnetic system of the "Witton" furnace enables so strong and centrally-situated a magnetic field to be available in the crucible for inducing the current in the charge, that it has been possible for the remainder of the electrical equipment to be made entirely subservient to considerations of safety and efficiency (both electrical and metallurgical). The "Witton" furnace works with a very low current consumption, due to unique features of design, which reduce losses in the equipment.

Figs. 1 and 2 show the "Witton" 6-cwt. furnace in the melting and in the pouring position respectively.

The General Electric Company, Limited, have concluded an agreement with Mr. Victor Stobie by which they have acquired the sole rights to manufacture and sell within the Empire high-frequency induction-type electric furnaces in accordance with his patents. These furnaces offer many important advantages for the production of high-grade steels and the melting of ferrous and some non-ferrous metals and alloys.

Fig. 1.—Melting Position.

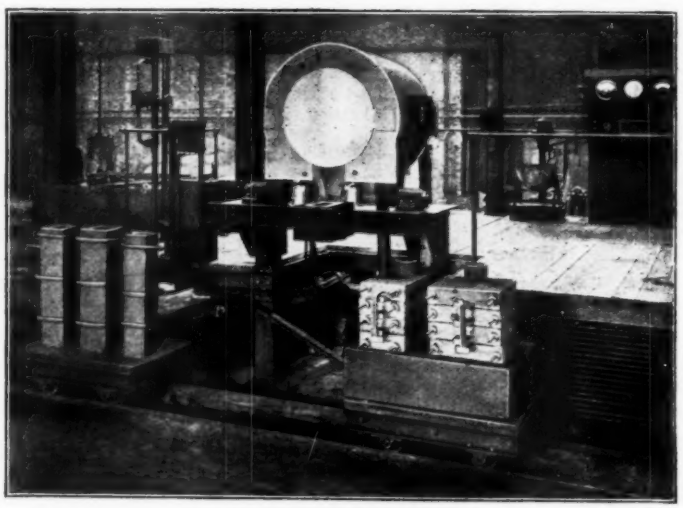

Fig. 2.—Pouring Position.

The "Witton" 6-cwt. High-Frequency Induction Furnace (Stobie Patent).

Melchett Medal.—At a meeting of the Institute of Fuel in London on February 1, Sir Hugo Hirst (President) presented the Melchett Medal to Prof. W. A. Bone, F.R.S. (Head of the Department of Fuel Technology at the Imperial College of Science), who, subsequently, delivered a lecture on "A Century of Fuel Economy," in the course of which he traced the progress made in this direction in connection with the manufacture of iron and steel, gas and coke and power production. In the evening Prof. Bone was the guest of honour at dinner held in the Connaught Rooms. Others present included Sir Philip Dawson, M.P., Sir Wm. Larke, K.B.E. (Director of the National Federation of Iron and Steel Manufacturers), and Dr. F. S. Sinnatt.

Iron and Steel in Manchuria.

Manchuria is both an important source of raw material for the iron and steel industry and an important consuming market for manufactured iron and steel. With extensive deposits of iron ore available and with coking coal quite near at hand, a variety of circumstances peculiar to Manchuria have dictated that, at least for the present, almost no iron ore shall be exported; that ore mined shall be locally transformed into pig-iron and then exported; and that steel production, although entirely possible, be deferred until such time as economic conditions shall justify it. The import trade in iron and steel products bears few distinguishing characteristics, save that it has declined in volume from year to year over the period 1928 through 1930.

At present there are known to be seven blast furnaces in Manchuria with a combined annual capacity of 382,000 tons of pig-iron. The Honkeike Iron Works (in Penhsihu) have two blast furnaces of 130 metric tons daily capacity, and two furnaces with a capacity of 25 tons or less per day—the estimated annual capacity being 102,000 tons. The Anshan Steel Works at present have three furnaces, two of 300 tons daily capacity and capable of producing 280,000 tons of pig-iron per year. This last company has been engaged in building a third furnace, but no word as to its commencing operations is at hand, although it was scheduled for completion in 1930. It will have a daily capacity of 500 tons and may be expected to increase materially the output of pig-iron in Manchuria. The erection of such a furnace naturally makes necessary an enlargement of coke supplies, and 50 coke ovens have already been added. A machine-casting plant is also in process of erection and will supersede the present casting of pig-iron in sand beds.

The export trade in pig-iron in point of tonnage has been less in each of the past three years. In 1928 a total of 244,413 metric tons of this material left Manchurian ports in export trade; in 1929, 229,529 tons were so shipped; while in 1930 222,869 tons were exported. Chinese export statistics do not indicate the destination of these shipments, but it seems safe to assume that nearly if not all of them went to Japan for making steel to supply the Japanese domestic industry.

Proposed Steel Works.

The erection of blast furnaces in Manchuria was naturally considered, in a measure, as a preliminary step toward the establishment of a steel industry there and numerous plans have been considered with this in view. A deterring influence has been the fact that these works would be outside the limits of the Japanese Empire and, therefore, would be subjected to all the handicaps of duty and freight charges that any foreign steelworks must meet to sell in Japan. The products of such a mill would also be required, in all probability, to pay an export duty to China, as is now collected on pig-iron shipped in this trade, and would thus have to bear a double handicap from this standpoint. It is reported that consideration is being given to the location of a large steel plant outside both Japan and Manchuria to make use of the Manchurian pig-iron, a site in Chosen (Korea) and one in the Kwantung Leased Territory having been mentioned.

With the production of iron and steel in Manchuria limited almost entirely to pig-iron, it is natural that a very considerable quantity of iron and steel would have to be imported into the territory for the supply of normal local requirements. The Chinese maritime customs report, "Foreign Trade of China," lists imports by customs districts, so that it was possible to determine with a fair degree of accuracy the quantity of iron and steel brought into Manchuria in 1928, 1929 and in 1930. Unfortunately, it was impossible to determine from this report the sources from which this particular material was drawn, the Chinese figures giving countries of origin including all imports into China, regardless of Province or customs district.

The great obstacle to the trade in pig-iron is the cost of the iron landed in Japan.—U.S. Commerce Report.

The Use of Flexible Couplings in Foundries.

(*Concluded from previous page.*)

amount of flexibility that is required varies with the application. Where machines will remain in approximate alignment, less flexibility is required than for applications where the misalignment may be considerable. In certain applications sufficient flexibility cannot be obtained in one coupling. Therefore, two are used, with a short length of shaft or floating ring between them.

The foregoing gives some of the factors to be considered when selecting and applying flexible couplings; to meet these conditions there is a wide variety of designs to select from. There is one feature common to all of them—if they are to give a high degree of satisfaction and long life, couplings must be given the same amount of attention as the machine of which they are a part.

An Efficient Moulding Plant for Cast-Iron Ingot Moulds for Steel Ingots.

By Robert Jones.

This article illustrates in detail the method employed in moulding the cast-iron ingot moulds of the type shown in Fig. 1. Some thousands of castings have already been successfully made by this process, and one of the chief features claimed is that it ensures an even and regular thickness of the walls of the mould, which is so vital in practice for this class of work.

Pattern Details.

The pattern, Fig. 2, is made of cast iron 3¼ in. at the small end shorter than the finished mould,

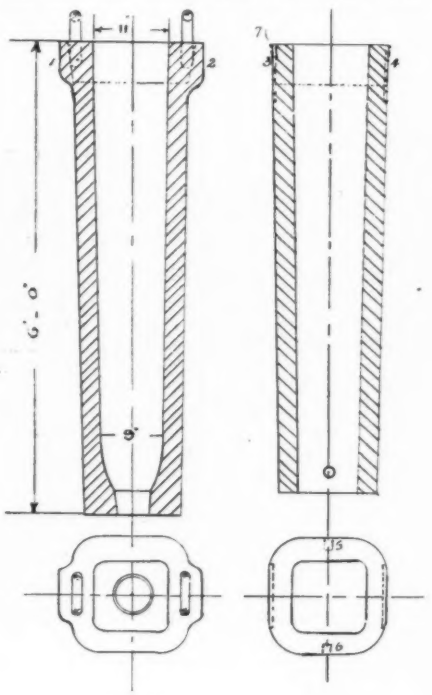

FIG. 1.

FIG. 2.

the reason for which will be referred to later. Provision for locating the thickness lugs 1 and 2 is made at the large end of this pattern as shown at 3 and 4, Fig. 2, also drilled holes 5 and 6 are provided to engage trunnion hooks on lifting chain, Fig. 3. A smooth surface is obtained on the inside of this pattern by the following

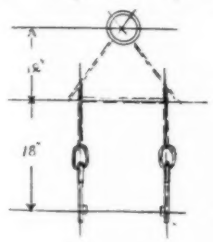

FIG. 3.

method. The wood saddle shown in Fig. 4 carries a stone block, chisel-shaped to the internal contour of the casting; this is drawn to and fro in a reciprocating fashion in turn on the four sides. Water is freely used during this operation.

The outside of the pattern is a simple matter for the file and emery, and when this is completed, the casting is warmed up and a coating of beeswax is applied and the desired smoothness is obtained. The tapered portion at point 7 is provided to ease the moulding.

The cast-iron bottom plates or seatings, Fig. 5, have a raised facing ½ in. in thickness, and the inside dimension is ⅜ in. larger than the outside

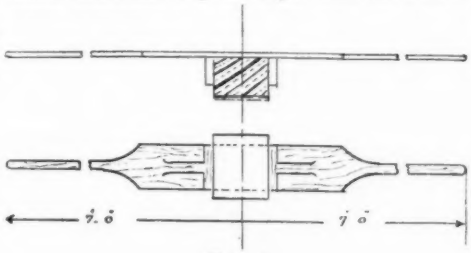

FIG. 4.

of the large end of the pattern when mounted with loop thickness lugs. Provision is also made for down pouring-runners at opposite corners *a*

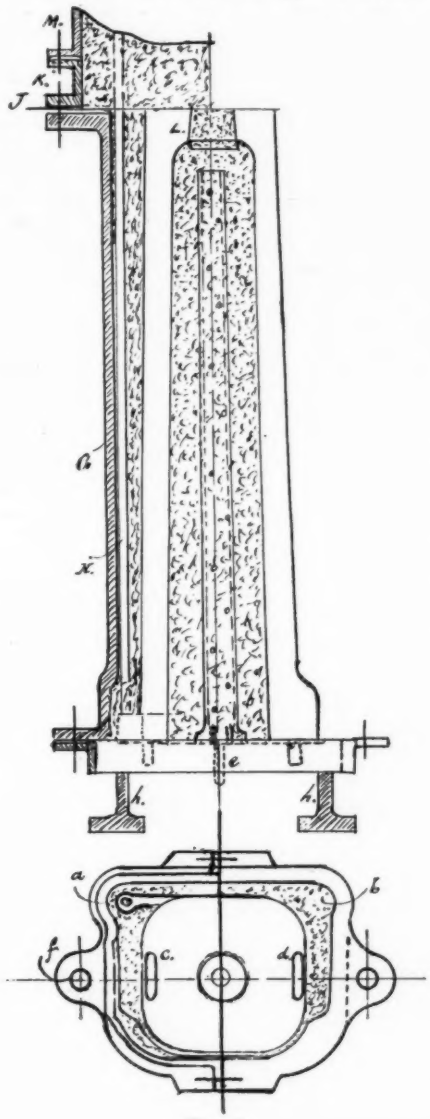

FIG. 5.

and *b*, Fig. 5; also pockets are provided to receive wrought-iron lifting loops *c* and *d*; facing ring for core bar flange; vent holes and core bar bolt *e* and centring cotter bolt *f* to locate the outside boxpart *g*.

Moulding Procedure.

The seating is now fixed on tee or channel iron supports *l* and sand rammed in the recess referred to and levelled off. The core bar (Fig. 6), having been previously prepared with rope binding in the usual way, is bolted in position, and flow gates (Fig. 8) are fixed in their respective positions. This face is now covered with a coating of parting sand. The seating is now ready prepared to receive the pattern (Fig. 2), the outside box G and the down gates H. Prepared sand for the core and outside is now rammed to the top of the pattern or joint J. The pattern block, Fig. 7, mounted with the plug-hole core-

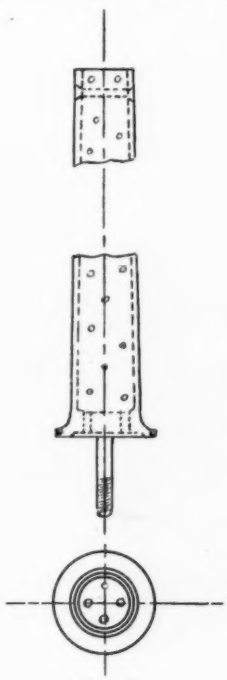

FIG. 6.

print, is fixed in position and ramming continued on the outside to the full length of the mould.

Joint J is now covered with a coating of parting sand and boxpart K (Fig. 5) is rammed in the usual way, and, when completed, it is withdrawn, blackened and treated in the usual manner and is now ready for transfer to the foundry drying stove.

The pattern block is now removed and the outside box G lifted off. This again is treated

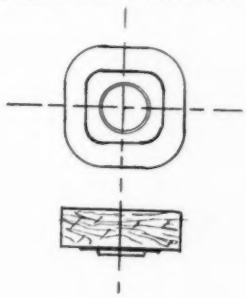

FIG. 7.

FIG. 8.

with a coating of plumbago wash and is ready for the drying stove. The plug-hole core L (Fig. 5) is now fixed in position and the pattern taken off the core by means of the trunnion hook chain (Fig. 3) suspended in the foundry crane. The core is trimmed by hand at the four corners as shown. The lifting hoops are fixed in their respective pockets and core and seating blackened together ready for drying.

Assembling the Mould.

The assembling together for casting is a comparatively simple operation. A casting pit is

(*Concluded on page* 106.)

Price Per Cwt.

By Practicien.

"Please quote us your lowest *price per cwt.* for the following material."

The above is typical of the greater number of inquiries received by ironfounders in many areas. To the average layman, this particular phrase appears hardly worthy of attention, but to almost every ironfounder those three words—price per cwt.—mean everything. Indirectly it is his "bread and butter."

Many firms do not care to give a price per cwt. on certain jobs, but if the customer specifically asks for such a form of quotation no other course is left open.

When trade was really good with a plentiful supply of orders for all, only a few grumbled about quoting a price per cwt. Why? For the simple and only reason that in certain jobs one could "cover" himself in the quotation. But to-day and for some time back trade has been bad. Good orders are few and far between and consequently one cannot afford to add a contingency item to a quotation. A quotation to-day must be keen and without "frills" if it has to have a sporting chance of getting the order. All ironfounders, especially those on jobbing work, are thus up against it and when giving a price per cwt. they are on very rocky ground. If a specified weight is given (with an over and under limit), a price per cwt. is quite satisfactory both to the trade and the customer. On the other hand, if no weight is stated both the ironfounder and the customer run the risk of being "got at," and a quotation on such lines is strictly non-competitive. There are many, no doubt, who will disagree with this latter assertion, but nevertheless it is a plain fact, and a very disagreeable one.

The following two cases illustrate how dangerous and unsatisfactory a price per cwt. can be. They are actual facts, and maybe are happening every day. The names are, of course, purely fictitious.

Case I.—Messrs. A. Smith & Company, Limited, ironfounders, receive an inquiry for 250 stanchion brackets in semi-steel. A rough sketch is enclosed but no weight is given. A price per cwt. is requested. The estimating department gets out an estimate, an outline of which is given below.

Customer: The West Lee Paper Co., Ltd., Birmingham.
Date: January 4, 1932.
Nature of Inquiry: 250 Semi-Steel Stanchion Brackets.
Remarks: To sketch.

Department.	Estimated Time.	Rate.	Cost.
			£ s. d.
Pattern Shop	26 hrs. ..	2s. 3d. per hr.	2 18 6
		Timber ..	1 0 0
Moulding Shop	600 hrs. the lot	4s. 3d. per hr.	127 10 0
	Total metal 750 cwt.	7s. per cwt. ..	262 10 0
Core-making	30 hrs. the lot	2s. 6d. per hr.	3 15 0
		Total	£397 13 6

Price per cwt., 10s. 7d. Quotation, 11s. per cwt.

The quotation is duly sent in at 11s. per cwt.—a ridiculously keen price. In the course of a few days information is received to the effect that the job has been placed at a more favourable price. Messrs. Smith's are, of course, disappointed but very surprised. A few weeks go by and their representative calls on the West Lee Paper Company, and during his conversation with their buyer is informed that the favourable quotation was 10s. per cwt. A large quantity of the brackets have already been delivered and are found to average 3 cwts. 2 qrs. to 4 cwts. Strike the average at 3 cwts. 3 qrs. and it gives a total weight of 937 cwts. 2 qrs. At 10s. per cwt. this gives a lump sum of £468 15s. Approximately £60 more than Smith's price, yet they did not get the job. One can, of course, turn round and say, "How do we know that Smith's will keep to the 3 cwts. per bracket?" The only satisfactory answer is—give an approximate weight in the quotation. Or, on the other hand, ask the customer to state a weight. Every quotation is then comparable and the customer can readily see which is the cheapest quotation.

Case II.—Messrs. B. Smith & Sons, Limited, receive any inquiry for 500 special roller castings and brackets to blue print. Customer will supply all patterns and coreboxes and a price per cwt. is to be given. An estimate is taken out as in Case I and the weight is estimated as accurately as possible from the blue print. Below is given a rough copy of the estimate:—

Customer: The Victory Chemical Co., Ltd., Newton.
Date: January 9, 1932.
Nature of Inquiry: 500 Roller Castings and Brackets.
Remarks: To Blue Print.
Customers' Patterns.

Department.	Estimated Time.	Rate.	Cost.
		s. d.	£ s. d.
Pattern Shop	Examining Patterns and making adjustments	—	1 0 0
Moulding Shop	800 hrs. the lot ..	3 6	140 0 0
Core-making	60 hrs. the lot ..	2 0	6 0 0
	Total metal, 500 cwt.	7 0	175 0 0
	Total ..	..	£322 0 0

Price per cwt., 12s. 10½d. Quotation, 13s. per cwt.

The quotation is ultimately accepted and the patterns forwarded. Work is begun, but after 250 of the castings have been made it is found that the total weight is only 210 cwts.—a reduction of 40 cwts. on the estimate. The patterns are then altered slightly, but on the completion of the job the total weight is only 450 cwts. The inquiry print has, of course, been returned with the quotation, and, thinking that some mistake has been made, the customer is asked for same. It is ultimately found that the patterns are not in strict accordance with the blue print, and an account for £325, less 50 cwts. at 7s. equals £307 10s. The customer, of course, refuses to pay and *expects a charge of 450 cwts. at 13s. per cwt.*, giving a total charge of £292 10s. A difference of £15 separates them, and the customer, unable to see the truth in the ironfounder's explanations, thinks he is badly treated. A settlement is reached at £300, and the customer then erases the firm from his books. Is it fair?

Conclusion.

Without doubt there are hundreds of cases similar to those outlined above. This article is not recommending the abolishment of price per cwt. Far from it, for even if it could be abolished similar snags would be found in a lump-sum price. There are always some buyers who refuse to act fairly, and, consequently, the founders have to endeavour to find a means of obviating any likelihood of misrepresentation. Weight is the governing factor of a price per cwt. job. It is the very foundation of the whole system, and thus it should be given in a price per cwt. inquiry or quotation. If such is done, both contractor and customer are on a parity, each being perfectly satisfied. If the buyer is endeavouring to cheat the ironfounder—well, he will deserve all he gets when trade becomes normal again!

The General Foundry & Engineering Company, Limited, is being wound up voluntarily. The liquidator is Mr. J. A. Garland, 148, Edmund Street, Birmingham.

The Continental Steel Cartel.

The internal differences in the Belgian group of the Continental Steel Cartel do not appear to have been settled, and it is understood that the further meeting of the managing committee of the Cartel has been postponed. Apart from the existing independent Belgian works, the Belgian group is said to demand an increase in its quota amounting to 860,000 tons, which would bring its quota to 4,246,000 tons per annum, whereas the Belgian steel production was only 3,056,000 tons last year and 3,270,000 tons in 1930. In the case of the Luxemburg works one claims an increase of 200,000 tons and another, the branch of a Belgian company, one of 36,000 tons. The question at issue seems for the moment to overshadow the problem of the formation of international selling syndicates for semi-finished material and joists.

An Efficient Moulding Plant for Cast-Iron Ingot Moulds for Steel Ingots.

(*Concluded from page* 105.)

provided in a convenient position in the foundry for this purpose, where the parts are put together ready to receive the molten metal. The runner-basin box M is rammed in position in green sand. Immediately the metal in the sand basin is solidified it is taken away to be remelted, and all the remaining parts are left intact until the following day.

The stripping of the mould is carried out in the following sequence: The complete mould is suspended in the foundry crane and core-bolt nut released; following this the seating is removed; then the boxpart containing the casting is placed over a pit provided for this purpose and the core bar after a few rappings on the bottom bolt falls away. After this it is removed to a convenient position, and the same process applied on the outside of the boxpart and the casting freely liberates itself. The castings produced by this method have been severely tested in practice for a considerable period and have given satisfaction to all concerned.

Syndicate of Polish Iron Foundries and Enamel Works.—The Syndicate of Polish Iron Foundries was formed at the beginning of last August and incorporated eight undertakings. There was only one dissident, but this has now also joined. The agreement is to last for three years and the scope of the Syndicate is to be widened by including enamelled ware.

A Large American Contract.—The exterior finish of the new Rockefeller buildings in New York is to be of limestone and aluminium, and aluminium spandrels have been ordered for the International Music Hall, the world's largest theatre, and the 31-story office building in the north block of the development. This order was placed with the Aluminium Company of America. The aluminium spandrels, or vertical panels between the windows, will cover about one-sixth of the exterior surface of the ten units planned for the development. The rest of the surfaces, exclusive of the windows, will be of limestone. The ten building units in the development will require over 1,350 tons of aluminium for the 22,000 spandrels. No contract for such a large amount of architectural aluminium has ever been placed before, and marks the first time that aluminium spandrels, with a semi-lustrous natural finish, have been used in combination with limestone for the architectural treatment of building exteriors. The effect produced by the use of aluminium spandrels will be a series of slightly-contracting vertical lines formed by the grey shadows of the windows and the soft grey shades of the aluminium panels. The reduction in weight on building columns and foundations resulting from the use of aluminium instead of heavier metals will be more than 3,000 tons. This results in ease and economy of erection. One man can easily handle a cast aluminium panel ¼ in. thick and 5 ft. square, while usually four men are required to handle a similar panel of heavier metal.

This Week's News in Brief.

Trade Talk.

MESSRS. HUNTON, LIMITED, machinery engineers, have removed from 126, Tottenham Court Road, W.1, to Phœnix Works, 114/116, Euston Road, London, N.W.1.

THE LONDON & NORTH EASTERN RAILWAY is to construct 54 new locomotives this year—42 tender and 12 tank engines—all of which it is proposed to build in the company's shops.

THE THREATENED lock-out of 90,000 workers in the Swedish iron, steel and engineering industries has been averted. An agreement has been signed on behalf of the workers and will remain in force until the end of the year.

THE FURNESS SHIPBUILDING COMPANY, LIMITED, Haverton Hill-on-Tees, has taken up shipbreaking in order to provide work for its employees. The company has bought the Elder Dempster steamer "Onisha" (8,000 tons) for breaking up.

THE CLEVELAND BRIDGE & ENGINEERING COMPANY, LIMITED, Darlington, has secured the contract for the foundations and steelwork of the new bridge over the Forth at Kincardine. The amount of the contract is stated to be £238,609.

THE BOARD OF TRADE announces that draft Orders-in-Council were laid before Parliament on February 2 requiring imported flush pipes of iron or steel to bear an indication of origin on sale or exposure for sale in the United Kingdom.

THE OTTOMAN RAILWAY has placed an order with Messrs. Robert Stephenson & Company, Limited, Darlington, for two 2-8-2 type locomotives, each with six-wheeled tenders. The Ottoman Railway is a British-owned undertaking, and operates 380 miles of track in Asia Minor.

EMPLOYEES OF THE following firms have contributed to charitable institutions during the past twelve months:—Messrs. Butters Bros. & Company, Glasgow, £104; Bull's Metal & Melloid Company, Limited, Yoker, £72; Polmadie & Govan works of the British Oxygen Company, £94 10s.; and Messrs. L. Sterne & Company, Limited, Glasgow, £88.

THE JOINT SECRETARIES of the Board of Conciliation for the Regulation of Wages in the Pig-Iron Trade of Scotland has been informed by the accountants that an examination of the employers' books for October, November and December, 1931, shows that the average net selling price was £3 8s. 8d. This means that there will be a reduction of 2 per cent. in the wages of the workmen, on basis rates.

A CONFERENCE OF REPRESENTATIVES of the municipalities of the Tyne, Wear and Tees, the large public utility companies, and the London & North Eastern Railway Company was held at Newcastle recently to consider the formation of an Industrial Development Board for the North-East Coast. The object in view is the attraction of new industries to the North of England, and valuable preliminary work in this direction has already been done by the Tyneside Industrial Development Conference.

MR. S. R. GILLOTT, of Sheffield, succeeded Mr. T. W. Ottewell (Dewsbury) as President of the Yorkshire Scrap Metals and Machinery Merchants' Association, at the annual meeting held in Leeds recently. Mr. Ottewell said that 1931 was one of the worst years the industry had ever known, but hope of an improvement was held out in the present year. Mr. S. Moorhouse (Huddersfield) was elected Vice-President and Mr. H. Ogden treasurer, and the following were appointed to the committee:—Messrs. H. Ash, A. Bacon, H. Bray, G. W. Butler, C. A. Hill, J. Leach, F. Mason, C. H. Reeve, N. Sanderson, C. Wailes, C. Waller, and J. Buxton.

A CONFERENCE of the Shipbuilding Employers' Federation and certain shipbuilding trade unions was held at Carlisle recently, when serious consideration was given to procedure issues arising from questions raised by employers on the North-East Coast in connection with conditions of work on the repair of oil ships. The employers have attempted to secure the agreement of the unions locally to investigate and discuss various problems with a view to the competitive ability of the district being improved. After a discussion of the question, the union representatives considered the position in private and intimated that, having regard to the fact that oil ships were repaired in other districts and the nature of the existing agreements in the industry, they were not prepared to countenance any local negotiations.

ON FRIDAY, JANUARY 29, the Rugby works of the British Thomson-Houston Company, Limited, were visited by the party of South African engineering students now touring this country. The visitors, numbering 24, and accompanied by Prof. W. G. Sutton, Dean of the Faculty of Engineering of the University of the Witwatersrand, were received by members of the B.T.H. Overseas Association. A number of the departments were visited before lunch, when the party was joined by Mr. A. P. Young, works manager; Mr. E. G. Taylor, Mr. R. C. Plowman and Mr. E. H. Ball, of the company's export department; and Mr. T. Wadsworth, of the engineering laboratory. After lunch the visitors were conducted round the various shops by members of the Overseas Association. The departments visited included the turbine, transformer and large electrical machine factories, the lamp factory, the fabricated construction department, the engineering laboratory and the acoustical department.

IN A STATEMENT reviewing the work of the past year, the Metropolitan-Vickers Electrical Company, Limited, states that, although the financial situation throughout the world has been very bad, the actual tonnage of the orders shipped from the company's works has nearly equalled the previous year's. Some of the largest turbo-generator sets ever sent out by the firm were shipped last year, and the same may be said of high-voltage switchgear and transformers. Referring to electric winders, it is recorded that during the year nine large Ward-Leonard winder equipments passed through the test department. Each of these equipments was supplied with the M.V. new hydraulic slip regulator, which was in every case tested with its equipment under conditions as near as possible to those obtaining on the site. In connection with iron and steel plant, it is reported that an order for a full automatic blast-furnace equipment, comprising a 130-h.p. skip-hoist motor, has been started up. The equipment comprises automatic control and sequence of the hoist motor, small and large bell-operating gear and revolving distributor gear, and raising and lowering of the test-sounding rods, each operation being sequence-controlled, so as to reduce delays to a minimum and to ensure even distribution of the material in the furnace.

Personal.

MR. W. M. MORDEY, Past-President of the Institution of Electrical Engineers, has been elected an honorary member of the Institution.

MR. JOHN LIMOND, who has been in the employ of the Dalmellington Iron Company, Limited (now Bairds & Dalmellington, Limited), for over 61 years, has just retired.

COL. CHARLES F. HITCHINS, D.S.O., M.I.Mech.E., M.I.N.A., has resigned his appointment as one of the managing directors of Sir W. G. Armstrong Whitworth & Company, Limited.

MR. WESLEY LAMBERT, C.B.E., consulting metallurgist, has changed his address from "Whitefriars," Bromley Road, Catford, to 28, Canadian Avenue, Catford, London, S.E.6.

MR. S. MCLEAN, lately director of Messrs. Daniel Adamson & Company, Limited, has joined the staff of Messrs. Hick, Hargreaves & Company, Limited, and will take charge of their turbine, turbo-compressor, turbo-blower and rotary compressor sales.

Wills.

SCOTT, GEORGE, of North Shields, a director of the Shields Engineering & Dry Dock Company, Limited, ironfounders and marine engineers £34,761

KIDNER, N. W., of Kettering, managing director of the Islip Iron Company, Limited, and chairman of Messrs. S. J. Claye, Limited, railway-wagon builders £158,750

Contracts Open.

Calcutta, March 10.—(Schedule 2) 15 locomotive boilers; (3) 14 sets locomotive cylinders and motion parts, for the Agent, East Indian Railway, Calcutta. The Director-General, India Store Department, Belvedere Road, Lambeth, London, S.E.1. (Fee 10s. each schedule, non-returnable.)

Farnham, February 18.—Two horizontal electrically-driven boosting pumps, for the Urban District Council. Messrs. J. Taylor & Sons, Caxton House, Westminster, S.W.1. (Fee £5, returnable.)

Ilford, March 10.—Two oil-driven generating sets, each including Diesel engines, alternators, switchboard, etc., for the Boroughs of Ilford and Barking Joint Sewerage Committee. Messrs. W. H. Radford & Son, Albion Chambers, King Street, Nottingham. (Fee £2 2s., returnable.)

Ilkley, February 15.—Stores: 9-in. bitumen lined steel pipes; 6 in. ditto; 4 in. ditto and fittings; 4-in. spun iron pipes and fittings; 4-in., 6-in., 9-in. and 15-in. valves and surface boxes, for the Urban District Council. The Surveyor, Town Hall, Ilkley.

Llandrindod Wells, February 22.—Pumping plant, comprising turbine pumps direct coupled to d.c. electric motors, for the Llandrindod Wells Urban District Council. Messrs. Fiddian & Deeley, 13, Church Street, Stourbridge. (Fee £2 2s., returnable.)

Morocco.—Phosphoric foundry pig-iron (P.L. No. 3), for a Casablanca firm. The Department of Overseas Trade. (Reference G.X. 11,110.)

Rayleigh, Essex, February 15.—Installation of two vertical centrifugal pumps and electric motors, etc., for the Rayleigh Urban District Council. Mr. W. E. Blizard, 25, Victoria Street, Westminster, S.W.1. (Fee £3 3s., returnable.)

Thundersley, February 22.—Installation of three vertical centrifugal pumps and electric motors, etc., for the Benfleet Urban District Council. Mr. W. E. Blizard, 25, Victoria Street, Westminster, S.W.1. (Fee £3 3s., returnable.)

U.S.A.—Conveyor chains, for a Detroit firm. The Department of Overseas Trade. (Reference G.X. 11,113.)

Wolverhampton, February 17.—Centrifugal pump, driven by electric motor, for the Corporation. Messrs. Dodd & Watson, Wellington House, Bennett's Hill, Birmingham. (Fee £1, returnable.)

New Companies.

British Industrial Ingot Metals, Limited, 1, Hick Street, Highgate, Birmingham.—Capital £100. Director: E. Cox.

Foundry Services, Limited.—Capital £500. Directors: E. Weiss, 36, Trafalgar Road, Moseley, Birmingham; F. Hadley and J. W. P. Smith.

Hanson, Fletcher & Company, Limited, Armley Foundry, Armley Road, Leeds.—Capital £2,000. Ironfounders. Directors: H. Hanson and H. Gosnay.

Company Report.

Hammond Lane Foundry Company, Limited.—Trading profit, £5,364; interest, dividends on investments, etc., £334; income-tax, £703; depreciation, £856; brought in, £792; final dividend of 5 per cent., making 10 per cent. for year; to investment account for depreciation, £500; carried forward, £1,134.

Obituary.

MR. F. MOORE, partner in the firm of B. Moore & Son, ironfounders, of Bingley, died on January 28, aged 50.

THE DEATH OCCURRED suddenly on February 4, in Messrs. Smith & Wellstood's foundry at Bonnybridge, of Mr. Samuel C. Stewart, who was formerly a marine engineer.

MR. JAMES B. A. REVIE, secretary of Messrs. Macfarlane, Strang & Company, Limited, Lochburn Iron Works, Glasgow, for many years, died suddenly while on holiday at Rothesay.

XUM

Raw Material Markets.

Throughout last week the iron and steel markets more or less hung fire, pending the disclosure of the Government's tariff proposals. New business is still at an abnormally low level. The announcement of a general 10 per cent. *ad valorem* duty on imports has created a more hopeful tone in the markets, but it is recognised that this will do little or nothing to keep out foreign iron and steel, and details of further protective measures are awaited. Deliveries of foundry iron in most districts are of moderately satisfactory volume, but the demand for finished steel is most disappointing, and producers have difficulty in keeping their mills employed. Orders booked by the Continental steelworks have temporarily shown a falling-off.

Pig-Iron.

MIDDLESBROUGH.—The new tariff has created a more optimistic tone in the Cleveland pig-iron market, but there has so far been little increase in actual business. There has been a slight improvement in local consumption. The greater part of the output is being consumed in the producers' own works, and the merchants hold very little Cleveland iron. Prices remain at the minimum level and are as follow:—No. 3 Cleveland G.M.B., 58s. 6d.; No. 1 foundry, 61s.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

Buyers on the East Coast hematite market have been inclined to await developments, and business has been quiet. Several export sales have been negotiated, but not for large tonnages. The makers are now generally quoting 64s. 6d. for East Coast mixed numbers and 65s. for No. 1 quality. Similar conditions prevail in the West Coast hematite market, but prices remain firm, Bessemer mixed numbers being at 66s. and low-phosphorus iron at 68s. 6d. to 71s. per ton, at works.

LANCASHIRE.—The pig-iron market has been quiet during the last few days, and new business is scarce. The prospect of a stoppage at the cotton mills, envisaged by the Burnley dispute, has cast rather a gloom over the market, in view of the fact that pig-iron deliveries to textile machinists have lately shown considerable improvement. In the meantime quotations are steady, with Midland foundry makes offered for delivery to users in the Manchester price zone at 67s. per ton, North-East Coast at 67s., Northamptonshire at 65s. 6d., Derbyshire forge iron at 62s., Scottish pig-iron at about 87s. and West Coast hematite at 81s.

MIDLANDS.—New business is scarce in the pig-iron market, and only small spot lots are being sold, as most consumers are already covered for some months ahead. For delivery to Birmingham and Black Country stations, makers continue to quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Business is very slow, and only a few odd parcels are being sold. No. 3 Scottish foundry remains at 69s. 6d. per ton, with 2s. 6d. premium for No. 1. No. 3 Cleveland iron is still offered at 60s. per ton at Grangemouth, with other English irons at about 2s. per ton less. Continental iron is practically off the market.

Coke.

The coke market in the Midlands remains steady, buying being of a hand-to-mouth character. Quotations remain unchanged. Best Durham foundry coke is at from 37s. 6d. to 39s., with other grades at 2s. 6d. less. Welsh coke varies according to grade, and is at anything from 30s. to 45s., delivered in the Birmingham district.

Steel.

Business in the finished-steel trade is very slack. A few orders are being placed, but the aggregate tonnage is far below normal. Many works are finding it difficult to maintain operations at an economic level. Business in Continental semis has been very limited during the past week, owing to the uncertainty of the tariff position. A bigger proportion of orders is going to the British works, but the total demand for semis is not on a very large scale.

Scrap.

In the Cleveland scrap iron and steel market business remains on a small scale. Heavy cast iron is quoted at 45s. per ton, and good machinery quality at 47s. 6d. per ton, broken into handy sizes. In the Midlands market new business for scrap iron is very difficult, and prices are weak. Heavy machinery metal varies from 47s. 6d. to 52s. 6d. per ton, delivered, while medium material is weak at 42s. 6d. to 45s. Light cast-iron scrap finds a fair demand at 37s. 6d. to 40s., delivered. In the Welsh and Scottish markets the prices quoted are mostly nominal, in view of the continued lack of demand.

Metals.

Copper.—The standard market has been disturbed by the tariff proposals, and, pending fuller details, dealers have been very cautious. The Exporters' reduced quotation of 6.875 cents per lb. is already being undercut, and a further reduction may be necessary. At the present moment the market is being supplied mostly by the Customs smelters and holders of second-hand metal. A limited demand is being experienced on both sides of the Atlantic, and the industrial outlook is not very promising.

Closing quotations :—

Cash.—Thursday, £37 12s. 6d. to £37 13s. 9d.; Friday, £37 15s. to £38; Monday, £36 5s. to £36 10s.; Tuesday, £36 6s. 3d. to £36 7s. 6d.; Wednesday, £35 15s. to £35 17s. 6d.

Three Months.—Thursday, £37 11s. 3d. to £37 12s. 6d.; Friday, £37 12s. 6d. to £37 15s.; Monday, £36 2s. 6d. to £36 5s.; Tuesday, £36 3s. 9d. to £36 5s.; Wednesday, £35 5s. to £35 7s. 6d.

Tin.—The market remains fairly steady, in spite of day-to-day fluctuations. The January tin statistics revealed an unsatisfactory discrepancy between supply and demand, but as this had already been fully anticipated, the effect on the market was not very serious. Consumers have not been buying, and the market is ruled by speculative interests. In the United States the tin statistics for the month of January show only a small increase in deliveries to consumers, and it is thought that the latter's stocks must now be at a low ebb, as they have long been working on as small a margin as possible.

Official closing prices :—

Cash.—Thursday, £139 2s. 6d. to £139 5s.; Friday, £139 10s. to £139 15s.; Monday, £138 5s. to £138 10s.; Tuesday, £138 5s. to £138 10s.; Wednesday, £137 to £137 5s.

Three Months.—Thursday, £141 15s. to £142; Friday, £142 5s. to £142 10s.; Monday, £141 2s. 6d. to £141 7s. 6d.; Tuesday, £141 to £141 5s.; Wednesday, £139 17s. 6d. to £140 2s. 6d.

Spelter.—The market has been hanging back until fuller details of the tariff scheme are available, and business has been on a small scale during the past week. Opinions differ as to the effect on the galvanising industry if a tariff is placed on imported semi-finished steel. It is of interest to note that British imports of spelter in 1931 totalled some 145,000 tons, while the united production of Canada and Australia was 157,000 tons, which indicates that the Empire could supply a large proportion of the home market's requirements.

Daily fluctuations :—

Ordinary.—Thursday, £13 16s. 3d.; Friday, £13 17s. 6d.; Monday, £13 17s. 6d.; Tuesday, £13 17s. 6d.; Wednesday, £13 15s.

Lead.—The market has been supported chiefly by speculators, and little business has been done with consumers, whose stocks are still on the heavy side. There is no sign of any expansion in demand. Russia has again been in the market for supplies, while Japan has bought 2,000 tons through Berlin agents.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £14 8s. 9d.; Friday, £15; Monday, £14 10s.; Tuesday, £14 10s.; Wednesday, £14 11s. 3d.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

30,984. ELLIOTT, A. Forming continuously-flanged openings in sheet metal. 361,069.

32,952. TRAUT, R. Process of and apparatus for lining tubes with protective materials by centrifuging. 361,090.

33,376. ROSSO, V. Process for bronzing iron and steel. 261,095.

21,401. HERAEUS - VACUUMSCHMELZE AKT.-GES. Method of increasing the creep limit or strength of metals and alloys. 363.306

31,854. DEL RIO, R. G. Manufacture of aluminium. 365,199.

36,407. CRABTREE, J. A. Production of metal boxes by casting. 363,492.

3.656. KRAMER, W., and KAMPF, A. (trading as Kramer & Company). Apparatus for casting metal. 363,542.

27,110. POTTS, H. E. (Electro Metallurgical Company). Ferrous alloys. 362,975.

38,598. PEMETZRIEDER, G. Centrifugal casting of metals. 363,142.

381. JOHANSSON, E. H. E. Method of coating objects of iron or steel with aluminium or aluminium alloy. 363,158.

27,574. PEMETZRIEDER, G. Casting of metals or alloys by centrifugal force. 362,035.

31,443. ARMSTRONG, WHITWORTH, & COMPANY (ENGINEERS), LIMITED, SIR W. G., and HALL, I. L. Open-flame furnaces for melting metals. 362,100.

20,044. BORNAND, E., and SCHLAEPFER, H. A. Moulds for casting metals. 362,333.

21,715. OSNABRUCKER KUPFER-UND BRAHTWERK. Casting metals. 362,338.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

FTJ. 11.2.32.

Pouring light Aluminium Alloy in a modern foundry.

3 L 11

3L11 is a very reliable non-porous aluminium-copper alloy; it is largely used for die-castings, and is suitable for pistons and similar high temperature services.

Specified chemical composition 6 to 8 per cent. copper; with or without addition of 1 per cent. tin.

Approximate melting point ..... 635° C.

Minimum tensile properties:—

Ultimate tensile strength tons/sq. in. ..... 9.

Per cent. elongation in 2 in. ..... 3.

All the British Standard alloys and many other alloys for special purposes are in regular production by the British Aluminium Co. Ltd.; it is usually best to buy metal in this way, already alloyed, from a reliable source.

Our booklet No. 328FJ includes data on alloys of aluminium. It will be sent gratis on request.

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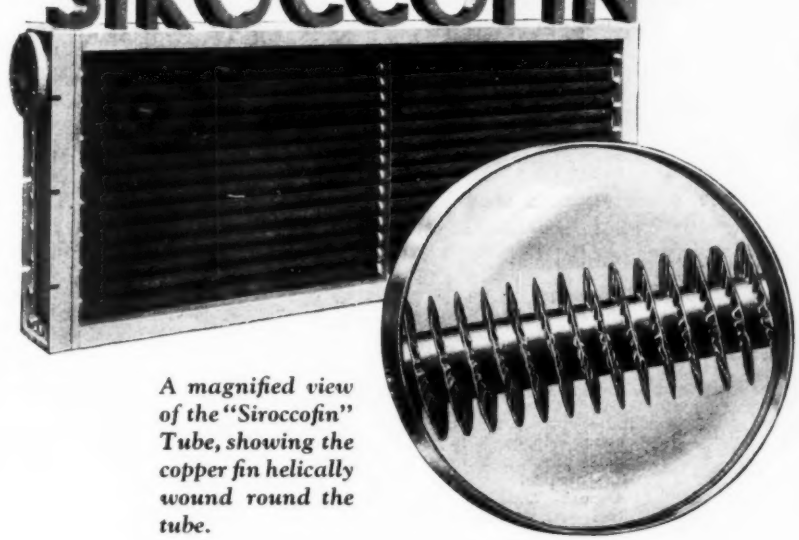
THE BRITISH ALUMINIUM Co LTD

ALUMINIUM PRODUCERS, ADELAIDE HOUSE, KING WILLIAM STREET, LONDON, E.C.4.

Telephone:— MANSION HOUSE 5564 & 8074 (5 LINES)

Telegrams:— "CRYOLITE, BILGATE, LONDON."

"SIROCCOFIN"



A magnified view of the "Siroccofin" Tube, showing the copper fin helically wound round the tube.

Write for Catalogue No. 30—

DAVIDSON & CO., LTD.

Sirocco Engineering Works,

BELFAST.

LONDON, MANCHESTER, BIRMINGHAM, NEWCASTLE, BRISTOL, CARDIFF, GLASGOW.

GILLED PIPE

AIR HEATERS

for Heating, Ventilating, or Drying Installations.

Efficient Heat Transmission. Economy of Space. Strong in construction and compact. Light in weight. Suitable for pressures up to 200 lbs. per square inch.

Supplied in standard sizes with tubes varying from 2 ft. to 10 ft. in length, which can be built up to form a heating battery of any number of sections.

TRADE SIROCCO MARK

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	35	15	0
Three months	35	5	0
Electrolytic	40	0	0
Tough	39	0	0
Best selected	39	0	0
Sheets	72	0	0
India	50	0	0
Wire bars	44	15	0
Do., March	43	17	6
Do., April	43	0	0
Ingot bars	44	15	0
H.C. wire rods	45	0	0
Off. av. cash, Jan.	39	10	1¼
Do., 3 mths., Jan.	39	12	9¾
Do., Sttlmnt., Jan.	39	9	7½
Do., Electro, Jan.	47	1	6
Do., B.S., Jan.	41	16	10½
Do., wire bars, Jan.	47	19	0
Solid drawn tubes			11d.
Brazed tubes			11d.
Wire			7½d.

BRASS.

Solid drawn tubes	9¼d.
Brazed tubes	11¼d.
Rods, drawn	8¼d.
Rods, extd. or rlld.	5¼d.
Sheets to 10 w.g.	8¼d.
Wire	8¼d.
Rolled metal	7¾d.
Yellow metal rods	5¼d.
Do. 4 × 4 Squares	6¼d.
Do. 4 × 3 Sheets	6¼d.

TIN.

	£	s.	d.
Standard cash	137	0	0
Three months	139	17	6
English	138	5	0
Bars	141	10	0
Straits	141	2	6
Australian	139	15	0
Eastern	—		
Banca (nom.)	154	5	0
Off. av. cash, Jan.	140	5	6½
Do., 3 mths., Jan.	143	6	3
Do., Sttlmt., Jan.	140	5	4½

SPELTER.

	£	s.	d.
Ordinary	13	15	0
Remelted	12	15	0
Hard	10	15	0
Electro 99.9	16	0	0
English	14	15	0
India	13	0	0
Zinc dust	23	0	0
Zinc ashes	3	10	0
Off. aver., Jan.	14	12	6
Aver. spot, Jan.	14	8	3¾

LEAD.

	£	s.	d.
Soft foreign ppt.	14	11	3
English	16	0	0
Off. average, Jan.	15	2	1½
Average spot, Jan.	15	1	8¼

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whf.	23	10	0
Rods	30	0	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.
Special brand, Eng.	40	0	0
Chinese (nom.)	28	0	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver (nom.)	17	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£6 12 6
45/50%	£12 0 0
75%	£16 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, 4/2, plus 55%, per lb. of Mo.	
Ferro-titanium—	
23/25% carbon-free	11¼d. lb.
Ferro-phosphorus, 20/25%	£21 12 6
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£34 0 0
4/6% car.	£24 2 6
6/8% car.	£23 0 0
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£36 10 0
Max. 1% car.	£41 2 6
Max. 0·70% car.	£51 0 0
70% carbon-free	11d. lb.
Nickel—80/99.5%	£240 to £245
Ferro-cobalt	9/3 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £ 9 0 0
Metallic manganese—	
94/96% carbon-free	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel				2	6	0
Bundled steel and shrngs.	1	17	0 to	1	18	0
Mixed iron and steel				2	1	0
Heavy cast iron				2	7	0
Good machinery for foundries	2	10	0 to	2	12	0
Cleveland—						
Heavy steel				2	0	0
Steel turnings				1	12	6
Cast-iron borings				1	6	0
Heavy forge				2	17	6
W.I. piling scrap				2	10	0
Cast-iron scrap	2	5	0 to	2	7	6
Midlands—						
Light cast-iron scrap				1	17	6
Heavy wrought iron				2	12	6
Steel turnings, f.o.r.				1	2	6
Scotland—						
Heavy steel				2	2	6
Ordinary cast iron				2	8	6
Engineers' turnings				1	11	6
Cast-iron borings				1	12	0
Wrought-iron piling				2	6	0
Heavy machinery				2	15	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	30	0	0
Brass	21	0	0
Lead (less usual draft)	12	0	0
Tea lead	9	0	0
Zinc	6	10	0
New aluminium cuttings	62	0	0
Braziery copper	27	0	0
Gunmetal	26	0	0
Hollow pewter	90	0	0
Shaped black pewter	70	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	65/-
Hematite M/Nos.	64/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
„ d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
„ No. 4 forge*	61/-
„ No. 3 fdry.*	66/-
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	57/6
„ fdry. No. 3*	62/6
„ fdry. No. 1*	65/6
Derbyshire forge*	61/-
„ fdry. No. 3*	66/-
„ fdry. No. 1*	69/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
„ No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
„ fdry. No. 3	63/6
Lincs forge	—
„ fdry. No. 3	63/6
E.C. hematite	74/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
„ fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/-
Clyde, No. 3	87/-
Monkland, No. 3	87/-
Summerlee, No. 3	87/-
Eglinton, No. 3	87/-
Gartsherrie, No. 3	87/-
Shotts, No. 3	87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	15	0 to	10	0	0
Nut and bolt iron	8	7	6 to	8	10	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				12	5	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	15	0 to	9	12	6
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)			6 15 0 & up.			
Flats—8 in. wide and over				8	12	6
„ under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	10	0
Black sheets, 24g.	8	0	0 to	9	0	0
Galv. cor. shts.				9	10	0
Galv. flat sheets	10	0	0 to	10	10	0
Galv. fencing wire, 8g. plain				12	10	0
Billets, soft	5	7	6 to	5	12	6
Billets, hard				6	12	6
Sheet bars	5	0	0 to	5	7	6
Tin bars				5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11½d.
Sheet to 10 w.g.	12½d.
Wire	13d.
Rods	11½d.
Tubes	17d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.64
No. 2 foundry, Valley	15.50
No. 2 foundry, Birm.	11.00
Basic	16.89
Bessemer	17.89
Malleable	17.89
Grey forge	17.44
Ferro-mang. 80%	75.00
O.-h. rails, h'y, at mill	43.00
Billets	27.00
Sheet bars	27.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.50
Tank plates	1.50
Beams, etc.	1.50
Skelp, grooved steel	1.50
Skelp, sheared steel	1.50
Steel hoops	1.65
Sheets, black, No. 24	2.15
Sheets, galv., No. 24	2.80
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 25/-
„ furnace	17/- to 18/-
Durham and Northumberland—	
„ foundry	14/6 to 15/-
„ furnace	14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		14/- to 14/9
„	28×20 „		28/- to 29/6
„	20×10 „		—
„	18¾×14 „		—
C.W.	20×14 „	12/9 to 13/-	
„	28×20 „	25/3	
„	20×10 „	19/4½	
„	18¾×14 „	13/9	

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	65%	57½%
Water ..	61½%	52½%
Steam ..	57½%	47½%

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Feb.	4 ..	37	12	6	dec.	5/-
,,	5 ..	37	15	0	inc.	2/6
,,	8 ..	36	5	0	dec.	30/-
,,	9 ..	36	6	3	inc.	1/3
,,	10 ..	35	15	0	dec.	11/3

Electrolytic Copper.

		£	s.	d.		
Feb.	4 ..	43	10	0	No change	
,,	5 ..	43	0	0	dec.	10/-
,,	8 ..	42	0	0	,,	20/-
,,	9 ..	42	0	0	No change	
,,	10 ..	40	0	0	dec.	40/-

Standard Tin (cash).

		£	s.	d.		
Feb.	4 ..	139	2	6	inc.	10/-
,,	5 ..	139	10	0	,,	7/6
,,	8 ..	138	5	0	dec.	25/-
,,	9 ..	138	5	0	No change	
,,	10 ..	137	0	0	dec.	25/-

Tin (English ingots).

		£	s.	d.		
Feb.	4 ..	140	10	0	inc.	5/-
,,	5 ..	141	0	0	,,	10/-
,,	8 ..	139	15	0	dec.	25/-
,,	9 ..	139	10	0	,,	5/-
,,	10 ..	138	5	0	,,	25/-

Zinc Sheets (English).

		£	s.	d.		
Feb.	4 ..	24	10	0	No change	
,,	5 ..	24	10	0	,,	,,
,,	8 ..	24	10	0	,,	,,
,,	9 ..	24	10	0	,,	,,
,,	10 ..	24	10	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Feb.	4 ..	13	16	3	dec.	1/3
,,	5 ..	13	17	6	inc.	1/3
,,	8 ..	13	17	6	No change	
,,	9 ..	13	17	6	,,	,,
,,	10 ..	13	15	0	dec.	2/6

Lead (English).

		£	s.	d.		
Feb.	4 ..	16	0	0	No change	
,,	5 ..	16	10	0	inc.	10/-
,,	8 ..	16	0	0	dec.	10/-
,,	9 ..	16	0	0	No change	
,,	10 ..	16	0	0	,,	,,

AVERAGE MONTHLY PRICES OF MARKED BARS (SOUTH STAFFS).

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1897	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0
1898	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	8 0 0	8 0 0	7 11 8
1899	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	9 0 0	9 0 0	9 10 0	10 0 0	10 0 0	10 0 0	8 3 4
1900	11 0 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 10
1901	9 10 0	9 10 0	9 10 0	9 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 16 8
1902	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 7 6
1903	8 5 0	8 5 0	8 5 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 8 9
1904	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 10
1905	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	8 1 8
1906	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 10 0	8 10 0	8 10 0	8 10 0	9 0 0	8 15 10
1907	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0
1908	9 0 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 5 10
1909	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1910	8 0 0	8 0 0	8 0 0	8 0 9	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1911	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1912	8 10 0	8 10 0	8 10 0	8 15 0	9* 0 0	9 0 0	9 0 0	9 8 0	9 10 0	9 10 0	9 10 0	9 15 0	9 1 6
1913	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	9 10 0	9 10 0	9 4 0	9 0 0	9 0 0	9 13 8
1914	8 12 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 14 4
1915	9 0 0	9 0 0	9 3 0	10 2 0	10 15 0	11 10 0	12 0 0	12 0 0	12 0 0	12 7 6	12 10 0	13 10 0	11 5 0
1916	13 10 0	13 10 0	14 13 0	15 0 0	15 0 0	15 0 0	15 0 0	15 10 0	15 10 0	15 0 0	15 10 0	15 0 0	14 18 7
1917	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0
1918	15 12 6	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	17 0 0	17 0 0	17 0 0	16 6 3
1919	18 0 0	18 10 0	20 0 0	20 0 0	23 0 0	23 0 0	23 0 0	24 12 0	25 0 0	25 0 0	25 0 0	25 5 0	22 10 7
1920	26 17 6	27 0 0	28 0 0	30 5 0	30 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	31 10 2
1921	31 10 0	30 3 4	27 10 0	27 10 0	27 10 0	24 15 0	21 0 0	20 0 0	20 0 0	17 10 0	17 0 0	16 0 0	23 7 4
1922	16 0 0	14 17 6	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 18 1½
1923	13 10 0	13 10 0	13 16 0	14 7 6	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 5 3½
1924	14 10 0	14 10 0	14 10 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 17 6	14 17 3½
1925	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 0 0	14 13 4
1926	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	*	14 10 0	14 0 10
1927	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 0 0	13 0 0	12 18 0	13 15 8
1928	12 10 0	12 10 0	12 10 0	12 2 6	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 2 8½
1929	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 7 6	12 10 0	12 10 0	12 2 3½
1930	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1931	12 10 0	12 10 0	12 10 0	12 8 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 3 2

* No quotation available.

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